

Drainage Report

UPS Parcel Distribution Facility

21612460

Prepared for
C2K Architecture
19800 Village Office Ct. #206
Bend, OR 97702

February 3, 2017



Document Information

Prepared for C2K Architecture
Project Name UPS Parcel Distribution Facility
File Reference 1246-Preliminary Drainage Report.docx
Job Reference 21612460
Date February 3, 2017

Contact Information

Cardno

5415 SW Westgate Drive, Suite 100
Portland, Oregon
97221

Telephone: 503-419-2500
Facsimile: 503-419-2600

Jim.Harper@cardno.com
www.cardno.com

Document Control

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
1	February 03, 2017	Luis Giron	LAG	Jim Harper	JH

© Cardno 2014. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

Table of Contents

1	VICINITY MAP	4
2	PROJECT DESCRIPTION	5
2.1	Project Overview	5
3	PRE-DEVELOPED CONDITIONS	5
3.1	Environmentally Sensitive Areas	5
3.2	Topography	5
3.3	Climate	6
3.4	Site Geology	6
3.5	Hydrology	6
3.5.1	Onsite Hydrology	6
3.5.2	Offsite Hydrology	6
3.6	Basin Areas	6
4	POST-DEVELOPED CONDITIONS	6
4.1	Hydrology	6
4.2	Basin Areas	7
5	HYDROLOGIC ANALYSIS DESIGN GUIDELINES	7
5.1	Design Guidelines	7
5.2	Western Washington Hydrology Model	7
5.3	System Capacities	7
6	Water Quality	8
6.1	Water Quality Facility	8
7	Conveyance Analysis	9
8	Qualitative Downstream Analysis	10
9	SUMMARY	17

Tables

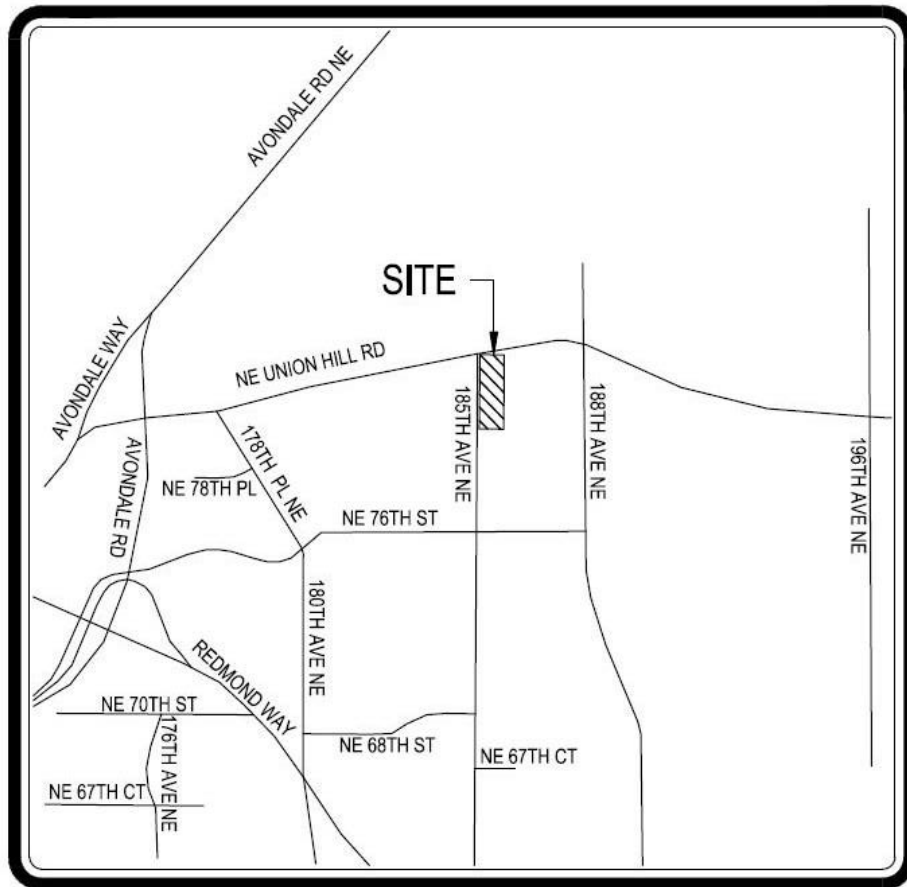
Table 3-1	Soil Characteristics	6
Table 3-2	Pre-Developed Basin Areas	6
Table 4-1	Post-Developed Basin Delineation Summary	7
Table 5-1	Flow Control Structure Geometry	7
Table 6-1	Water Quality Design	8
Table 6-2	Water Quality Capacity	9
Table 7-1	MRI Values	9
Table 7-2	Stormwater Flow Values for Sub-Basins	10
Table 7-3	Stormwater Flow Values for Sub-Basins	10

Figures

Figure 1-1	Vicinity Map	4
Figure 5-1	Volume Curve for 84" Duromaxx	8

1 VICINITY MAP

Figure 1-1 Vicinity Map



VICINITY MAP
SCALE: NTS



2 PROJECT DESCRIPTION

2.1 Project Overview

United Parcel Service is proposing construction of an additional parking lot for its parcel distribution facility to be located on the southeast corner of the NE Union Hill Rd. and 185th Ave NE intersection, See Figure 1-1. The site consists of approximately 3.27 acres zoned MP (Manufacturing Park).

The purpose of this report is to describe the stormwater management systems proposed as part of the new development and how they conform to water quality standards and regulations for the City of Redmond, King County and the Washington Department of Ecology. The total impact area for this development is approximately 2.65 acres.

The proposed storm improvements include collecting and conveying stormwater runoff from the proposed parking lot to an existing stormwater sewer located within 185th Ave NE Right-Of-Way. The proposed stormwater improvements will meet the required standards for the City of Redmond, King County, and the Washington Department of Ecology for stormwater quality, quantity, and conveyance. The existing stormwater infiltration pond is to remain with drainage patterns unchanged.

The conveyance detention standards for the City of Redmond, King County, and the Washington Department of Ecology have been met by using the Western Washington Hydrology Model to model the stormwater runoff generation for proposed and existing conditions. All runoff from the proposed impervious areas will be conveyed to the existing 12-inch storm sewer pipe located within 185th Ave NE.

Contech Duromaxx steel reinforced polyethylene pipes will provide the necessary detention volume to keep post-development stormwater flows from exceeding pre-development flows. A BioClean Linear Modular Wetland vault is proposed to treat stormwater runoff from the proposed impervious areas downstream of the detention facility. The proposed water quality facility has general use level approval from the Washington Department of Ecology for basic and enhanced treatment types.

3 PRE-DEVELOPED CONDITIONS

3.1 Environmentally Sensitive Areas

The existing site does not have any wetlands mapped by the U.S. Fish and Wildlife Service National Wetlands Inventory. There is a Freshwater Emergent Wetland and A Freshwater Forested/Shrub Wetland approximately 0.1 miles northwest of the property. The general topography of 185th Ave NE and NE Union Hill Rd drains south away from the wetlands and they are likely to remain unaffected by drainage generated from proposed improvements. No threatened or endangered species are mapped by the U.S. Fish and Wildlife Service Threatened & Endangered Species Active Critical Habitat Report. The City of Redmond uses groundwater as a primary water source and maintains specific guidelines in order to protect groundwater quality. The site is located within Wellhead Protection Zone 1 where new construction of stormwater infiltration facilities is prohibited.

3.2 Topography

The existing site is currently undeveloped and contains a stormwater detention pond of roughly 0.08 acres, 1.16 acres of flat (0-5% slopes) pervious area, 1.16 acres of moderately sloped (5-10% slopes) pervious area, and 0.78 acres of steep (>15% slopes) pervious area. The highest elevation of 76' is located approximately 100' north of the existing stormwater pond. The bottom of the existing stormwater pond is the lowest elevation of 47.4'. General slope direction onsite is east to west towards 185th Ave NE. Slopes used to model predeveloped conditions were determined with a USGS Topography map circa 1950. See Technical Appendix: Exhibit 1 – Redmond Quadrangle (N4797.5-W12200/7.5).

3.3 Climate

The site is located in King County approximately 110 miles inland from the Pacific Ocean. Average annual temperatures range from 45°F to 61°F and average annual rainfall recorded in this area is 38 inches.

3.4 Site Geology

The underlying soil type onsite, is classified by the United States Department of Agriculture Soil Survey of King County, Washington, are identified in Table 3-1. See Technical Appendix: Hydrologic Soil Group - King County.

Table 3-1 Soil Characteristics

Soil Type	Hydrologic Group
Everett very gravelly sandy loam	A

3.5 Hydrology

3.5.1 Onsite Hydrology

The existing on-site conditions are predominately pervious. Stormwater drains west towards 185th Ave NE due to existing topography. There is an existing stormwater detention pond on the southern portion of the site which infiltrates stormwater runoff from an existing UPS parking lot located west of 185th Ave NE. Runoff from the existing parking lot is treated by a bio-infiltration swale prior to infiltration.

3.5.2 Offsite Hydrology

A stormwater swale runs north-south along the east side of 185th Ave NE, within a utility easement, which treats runoff from the existing sidewalk and roadway surface. Excess stormwater is conveyed by an 8-inch overflow pipe into the existing stormwater sewer. The stormwater sewer flows south along 185th Ave NE and then flows west along NE 76th St. Flow then continues along NE 76th St until it crosses US Highway 520 where it then discharges into a stormwater ditch that drains into Bear Creek.

3.6 Basin Areas

Basin areas for pre-developed conditions are shown in Table 3-2. The total property area used for this analysis is 2.65 acres out of the parcel's 3.27. The existing sidewalk and stormwater swale within the utility easement located on the east side of 185th Ave NE were not included in the analysis since they are part of a separate basin.

Table 3-2 Pre-Developed Basin Areas

Basin	Area (sf)	Area (ac)
Moderate Slope	57609	1.32
Steep Slope	57609	1.32
Total	115219	2.65

4 POST-DEVELOPED CONDITIONS

4.1 Hydrology

Drainage patterns of the subject property are not affected by offsite hydrology due to existing topography. Proposed site grading will preserve offsite drainage patterns and will not require the treatment, detention and conveyance of offsite runoff. No stormwater runoff generated by new impervious surfaces will be allowed to drain offsite. Runoff will be captured via catch basins, routed to detention pipe and then conveyed to a biofiltration

vault where runoff will be treated to required levels. Metered flow will be discharged into the existing stormwater sewer where it will eventually make its way to Bear Creek.

4.2 Basin Areas

The impervious and pervious surface areas for the post-developed conditions are shown in summary in Table 4-1. As mentioned above, the total property area used for this analysis is 2.65 acres. (See Technical Appendix: Post-Developed Basin Summary Delineation).

Table 4-1 Post-Developed Basin Delineation Summary

Basin	Impervious Area (sf)	Impervious Area (ac)
Flat Lawn	11546	0.265
Moderate Lawn	7509	0.172
Steep Lawn	6547	0.150
Moderate Parking	89803	2.062
Total	115404	2.649

5 HYDROLOGIC ANALYSIS DESIGN GUIDELINES

5.1 Design Guidelines

The site is located within jurisdiction of the City of Redmond. The analysis and design criteria used for stormwater management described in this section will follow Washington Department of Ecology's Stormwater Management Manual for Western Washington, amended in December 2014, and the City of Redmond's Clearing, Grading, and Stormwater Management Technical Notebook (Technical Notebook), amended February 2012.

5.2 Western Washington Hydrology Model

The detention system to accommodate stormwater runoff from the proposed site improvements was modeled and sized with the Western Washington Hydrology Model (WWHM). WWHM is a continuous model which calculates runoff and detention volumes continuously based on historical data from 1948 to 2009. Onsite soils were modeled as till Group C soils due to excessively drained conditions. According to the City of Redmond's Clearing, Grading, and Stormwater Technical Notebook, proposed projects within Wellhead Protection Zones (WPZ) 1 and 2 are allowed to be modeled as Group C soils for flow control. Stormwater infiltration is prohibited in WPZ 1 and 2 and onsite infiltration rates in these areas are usually so large that design and construction of a detention facility that preserves pre-developed conditions would be impractical.

5.3 System Capacities

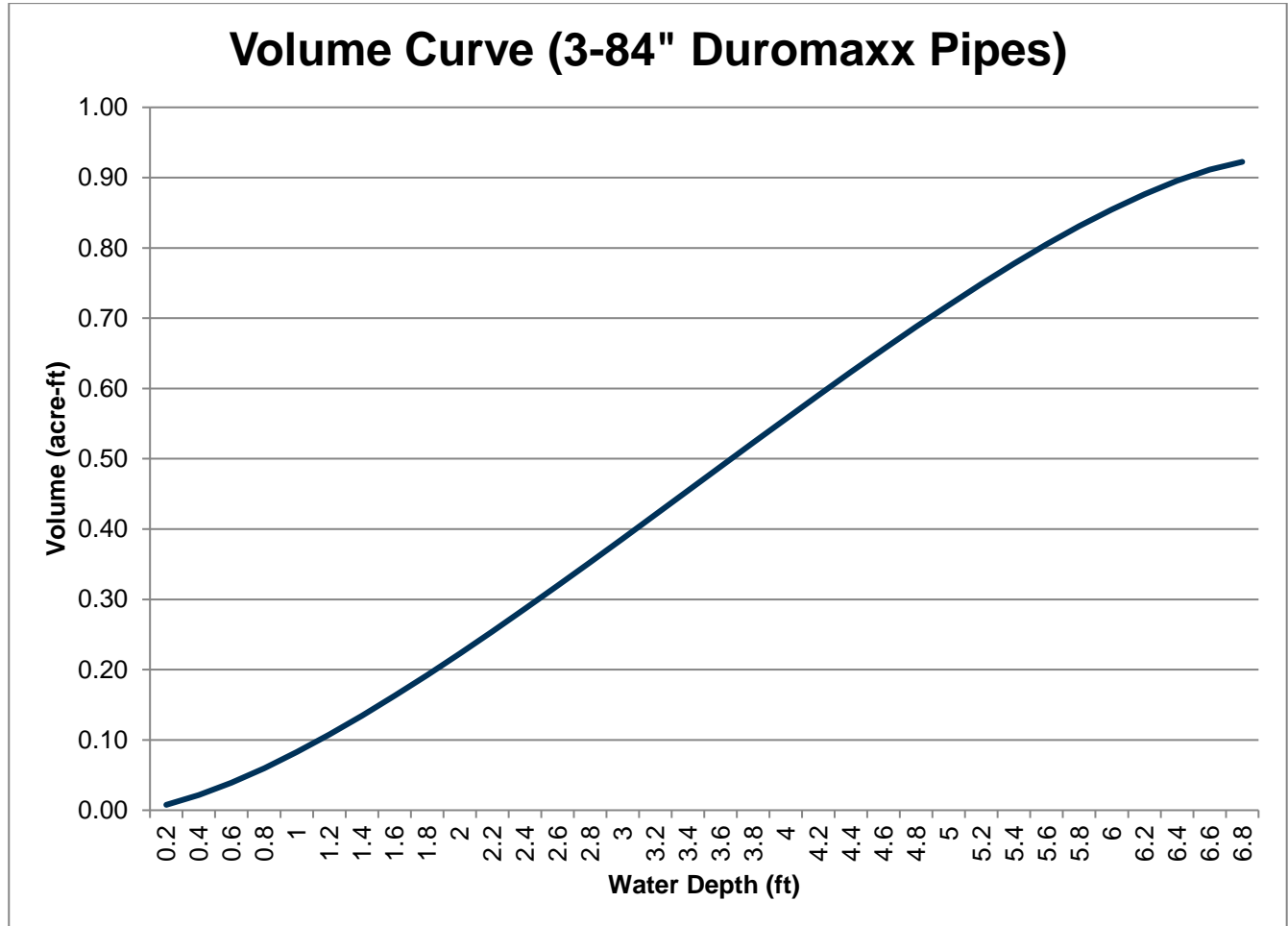
Results from the WWHM (See Technical Appendix – WWHM2012 Project Report) indicate that the proposed subsurface detention facility must provide at least 0.896 acre-feet of storage in order to maintain post development discharge rates from 50% of the 2-year peak flow to the full 50-year peak flow at pre development levels. The flow control structure is to consist of a 54-inch diameter precast manhole with a flow control tee and riser. The riser shall be 5.89 feet tall and have a diameter of 18-inches. Orifice dimensions and locations are indicated in Figure 5-1 below.

Table 5-1 Flow Control Structure Geometry

Orifice Diameter (inches)	Height (feet)
1.03	0.0000
1.55	3.53
0.93	4.02

Detention capacity will be provided by three Contech Duromaxx 7-foot diameter, 320-feet long steel reinforced polyethylene pipes. Pipes are to have one foot of freeboard and a combined capacity of 0.92 acre-feet. A volume curve for the proposed detention facility is presented below. WWHM output data can be found in the Technical Appendix section at the end of this report.

Figure 5-1 Volume Curve for 84" Duromaxx



6 Water Quality

6.1 Water Quality Facility

Per Section I-2.5.6 of the Stormwater Management Manual for Western Washington, projects with pollution-generating hard surfaces in excess of 5,000 square feet require treatment of stormwater runoff. Three BioClean Modular Wetland Biofiltration systems are proposed to treat stormwater runoff from the new parking lot and are to be constructed downstream of the proposed detention vaults. The Biofiltration system must be sized to treat the stormwater runoff volume generated from a 6-month, 24-hour storm event. Design requirements for the proposed development are summarized in Figure 6-1 below. Design values were determined with the Western Washington Hydrology Model.

Table 6-1 Water Quality Design

Design Water Quality Flow and Volume

Off-line facility target flow	0.0285 cfs
-------------------------------	------------

Stormwater runoff for the proposed parking lot will be treated with a 4' x 4' Bioclean MWS Linear Vault. The water quality treatment capacity of the MWS Linear should provide adequate stormwater treatment considering design parameters. All MWS Linear Vaults are off-line treatment facilities and require a minimum of 3.4-ft of operating head between inlet and outlet inverts. An internal bypass wier is built into the 4' x 4' MWS Linear in order to bypass flows exceeding treatment flow capacity. See Figure 6-2 for MWS Linear water quality capacity values.

Table 6-2 Water Quality Capacity

Water Quality Flow and Volume Capacity

Model	Treatment Flow Rate
MWS-V-4-4	0.052 cfs

7 Conveyance Analysis

They proposed stormwater piping network was analyzed using the Rational Method to size storm drain piping for adequate conveyance. The 2015 Washington Department of Transportation Hydraulics Manual (Hydraulics Manual) was referenced for the determination of Mean Recurrence Interval (MRI) Values, Runoff Coefficients, and Ground Cover Coefficients. MRI values for Seattle, Washington were used in calculating stormwater runoff flow since the Western Washington Hydrology Model uses rain data from Seattle to size detention facilities. According to Technical Notebook, conveyance systems upstream of detention facilities should be designed to convey the 50-year flow. MRI Values for Seattle were determined from Figure 2-5.4A in the Hydraulics Manual and are summarized in the Table 7-1 below.

Table 7-1 MRI Values

	50-Year
m	7.88
n	0.545

Onsite soils exhibit infiltration rates greater than 50 inches per hour and landscape areas are unlikely to generate any appreciable stormwater runoff flow, and were neglected from the analysis. Flow regimes over the proposed parking lot will consist of sheet flow and gutter flow thus ground cover coefficients of 1,200 (paved) and 1,500 (gutter) were selected from Figure 2-5.3 in the Hydraulics Manual. A minimum time of concentration of 5-minutes was used for analysis since time of concentration calculations for sheet and gutter flow resulted in values smaller than 5-minutes. Runoff Coefficients are tabulated in Figure 2-5.2 of the Hydraulics Manual for the 10-year peak storm. According to the Hydraulics Manual, Runoff coefficients should be factored for use with higher intensity storms to compensate for soil saturation. However, as mentioned above, onsite soils exhibit high infiltration rates, so a Runoff Coefficient of 0.9 was chosen. Runoff Coefficients and Ground Cover Coefficients used for conveyance analysis are summarized below.

Rainfall intensity was calculated to be 3.28 inches per hour using equation 2-4 below from the Hydraulics Manual.

$$I = \frac{m}{(T_c)^n} \quad (2-4)$$

Where:

- I = rainfall intensity in inches per hour (millimeters per hour)
 T_c = time of concentration in minutes
 m & n = coefficients in dimensionless units (Figures 2-5.4A and 2-5.4B)

The proposed parking lot was split into sub-basins and the corresponding stormwater flows were calculated. See the Post-Developed Basin Delineation for Conveyance in the Technical Appendix. Table 7-3 provides a summary of flow rates generated by parking lot sub-basins.

Table 7-2 Stormwater Flow Values for Sub-Basins

Sub-Basin	Area (ac.)	Flow (cfs)
A	0.196	0.578
B	0.249	0.734
C	0.384	1.132
D	0.189	0.557
E	0.249	0.734
F	0.249	0.734
G	0.105	0.310
H	0.314	0.926
I	0.131	0.386

Pipe sizes, lengths and slopes are also indicated in the Post-Developed Basin Delineation for Conveyance. Table 7-4 contains Manning's Equation calculations for the proposed storm system.

Table 7-3 Stormwater Flow Values for Sub-Basins

CONVEYANCE DATA (50-YEAR STORM EVENT)										
UPS Redmond - Redmond, Washington										
Sub Basin	Location Station		Conduit Properties		Conduit Results					
	From	To	Diameter	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0
			ft	%	cfs		cfs	ft/s	ft	
C	CB - (134)	CB - (52)	0.67	2.15	1.77	0.65	1.14	5.40	0.39	0.59
C+B	CB - (52)	DETENTION	0.83	2.66	3.57	0.53	1.88	6.64	0.43	0.52
A	CB - (53)	DETENTION	0.50	34.61	3.30	0.20	0.65	13.05	0.15	0.30
F	CB - (109)	CB - (106)	0.83	0.30	1.20	0.63	0.76	2.33	0.48	0.58
F+E	CB - (106)	DETENTION	1.00	0.30	1.95	0.76	1.48	2.73	0.65	0.65
D	CB - (136)	DETENTION	0.50	10.16	1.79	0.34	0.60	8.22	0.20	0.40
G	CB - (72)	DETENTION	0.67	0.30	0.66	0.47	0.31	1.86	0.32	0.49
I	CB - (95)	DETENTION	0.67	0.30	0.66	0.59	0.39	1.98	0.37	0.56
H	CB - (34)	DETENTION	0.83	0.30	1.20	0.77	0.93	2.43	0.55	0.66
	DETENTION	WATER QUALITY	1.00	0.30	1.95	1.08	2.10	2.74	0.94	0.94
	WATER QUALITY	STORM SEWER	1.00	0.75	3.09	1.08	3.32	4.33	0.94	0.94

8 Qualitative Downstream Analysis

A qualitative downstream analysis was prepared using GIS data provided by the City of Redmond. Downstream analysis included review of stormwater infrastructure beginning from the intersection of 185th Ave NE and NE Union Hill Rd to the point where Bear Creek crosses Redmond Way, near the intersection of Redmond Way and NE 76th St.

Stormwater runoff from improvements to 185th Ave NE are conveyed through an existing bioretention swale which runs the entire western length of the subject property. An 8-inch underdrain pipe conveys overflows from the bioretention swale to a 12-inch pipe. The 12-inch pipe then crosses over to the west side 185th Ave NE and flows south towards NE 76th St. The figures below illustrate the pipe size, slope and length of the existing stormwater sewer.

Figure 8-1 12-inch Pipe



12-inch pipe is indicated in blue in Figure 7-1. The pipe length runs for approximately 121 lf and then transitions into 18-inch pipe for the remaining distance to NE 76th St. This section of the storm sewer drains catch basins on either side of 185th Ave NE.

Figure 8-2 18-inch Pipe



Figure 7-2 depicts the existing stormwater sewer consisting of 18-inch pipe. It appears that some onsite stormwater facilities are draining into the public storm sewer in addition to catch basins in the roadway.

Figure 8-3 18-inch Pipe



Figure 7-3 shows connection points to the 18-inch public storm sewer. Once again, drainage consists of roadway catch basins and a couple connections from private stormwater facilities.

Figure 8-4 18-inch Pipe



The 18-inch pipe illustrated in Figure 7-4 transitions to a 24-inch pipe at the corner of 185th Ave NE and 76th St NE. This section of the stormwater sewer drains catch basins along 185th Ave NE.

Figure 8-5 24-inch Pipe



The storm sewer continues westward along the north side of NE 76th St for approximately 235 lf with 24-inch pipe. The 24-inch pipe then crosses over to the south side of NE 76th St and continues west for approximately 362 lf. Drainage for this section of the stormwater sewer originates from private stormwater facilities and catch basins along NE 76th St.

Figure 8-6 30-inch Pipe



Figure 7-6 depicts the transition to 30-inch pipe which begins near the eastern end of parcel 2212950013 and continues west on NE 76th St for 911 lf.

Figure 8-7 30-inch Pipe



Figure 7-7 is a continuation of the stormwater sewer section consisting of 30-inch pipe. This section of storm sewer drains a catch basin at the intersection of NE 76th St and 178th PI NE in addition to drainage conveyed from 180th Ave NE.

Figure 8-8 36-inch Pipe



Figure 7-8 depicts the 36-inch storm sewer running along the southwest side of 178th PI NE. The public storm sewer transitions from 30-inch pipe to 36-inch pipe at the intersection of NE 76th St and 178th PI NE and continues along the southwest end of 178th PI NE for 224 lf. Drainage in this section of public sewer consists of roadway runoff.

Figure 8-9 48-inch Pipe



The public storm sewer transitions from 36-inch pipe to 48-inch pipe as indicated in Figure 7-9. Drainage from a few private stormwater facilities is conveyed into the public storm sewer in addition to runoff from NE 76th St.

Figure 8-10 48-inch Pipe



Figure 7-10 shows the existing storm sewer consisting of 48-inch pipe. This section of existing storm sewer drains stormwater runoff originating from Fred Meyer, Kohl's and NE 76th St.

Figure 8-11 48-inch Pipe



Figure 7-11 is a continuation of the existing storm sewer consisting of 48-inch pipe. This section of existing storm sewer drains stormwater runoff originating from Kohl's and Univar USA.

Figure 8-12 Stormwater Ditch



Stormwater conveyed from the 48-inch pipe discharges into an existing stormwater ditch that drains into Bear Creek, just north of Redmond Way. The ditch length is approximately 470 lf and has an 8% slope, see Figure 7-12.

9 SUMMARY

The proposed stormwater management approach follows the *Clearing, Grading, and Stormwater Management Technical Notebook* issued by the City of Redmond in February 2012 and the *2012 Stormwater Management Manual for Western Washington* amended by the Washington Department of Ecology in December 2014.

As previously mentioned, stormwater runoff treatment for the proposed parking lot will be provided by three BioClean Modular Wetlands systems and the detention system will consist of Duromaxx pipe chambers. StormTrap vaults will be installed in the area of the existing stormwater infiltration pond with no change in the quantity of stormwater disposal. The functionality of the existing infiltration facility will essentially be unmodified since no changes in drainage patterns are proposed.

The proposed storm water management system meets the requirements of the City of Redmond and the Washington Department of Ecology for stormwater conveyance and treatment.

UPS Parcel Distribution Facility

TECHNICAL APPENDIX

Technical Appendix

- > Hydrologic Soil Group – King County
- > Pre-Developed Basin USGS Topography
- > Existing Conditions
- > Post-Developed Basin Delineation
- > Post-Developed Basin Delineation for Conveyance
- > Geotechnical Report
- > WWHM UPS Redmond – Output Report

References

1. *Stormwater Management Manual for Western Washington*. issued in 2012, amended December 2014 – State of Washington Department of Ecology
2. *Clearing, Grading, and Stormwater Management Technical Notebook*. issued in August 2010, amended February 2012 – City of Redmond
3. *Soil Survey of King County Area*. National Resource Conservation Service
4. *Hydraulics Manual*. Issued in 2015 – Washington State Department of Transportation



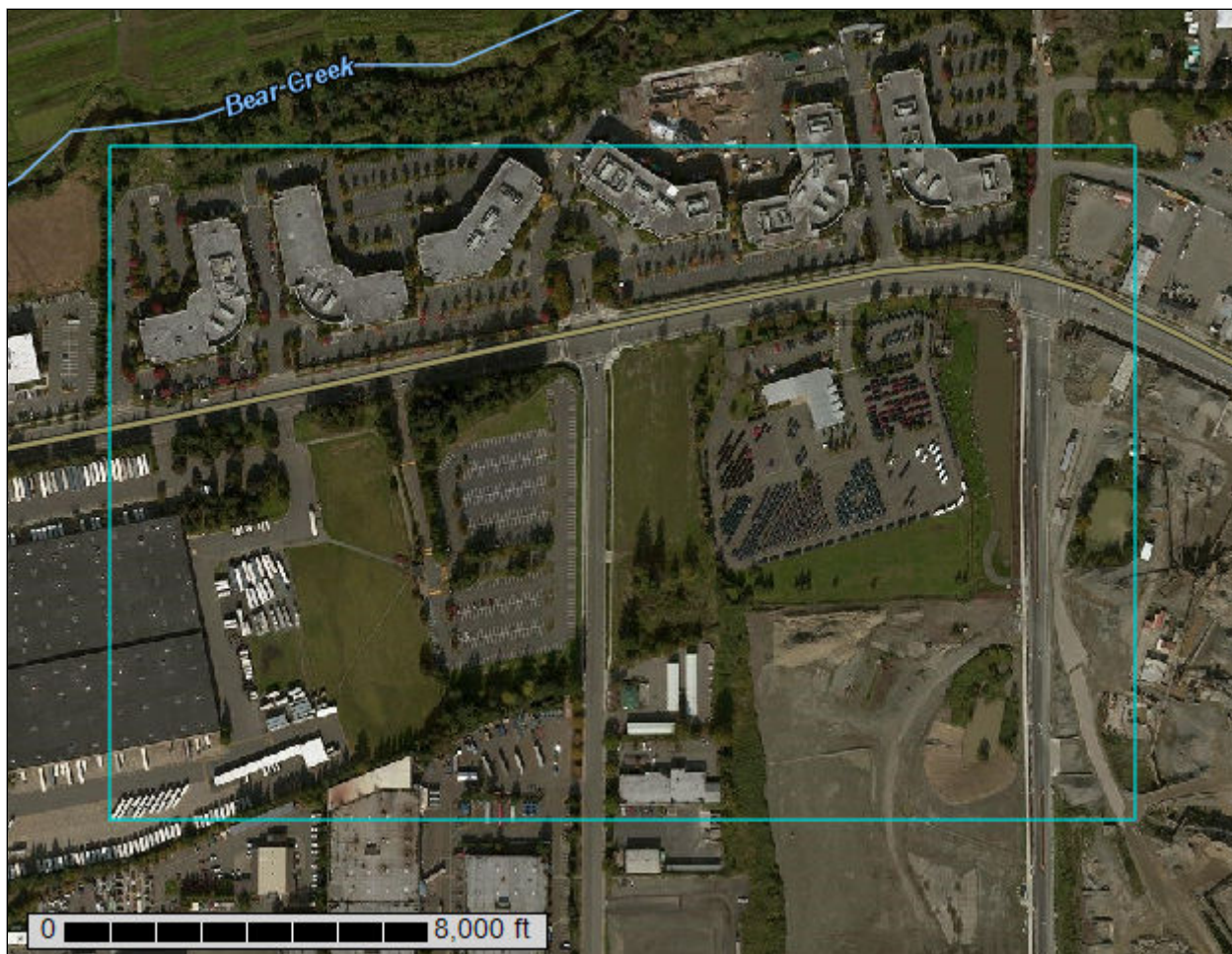
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **King County Area, Washington**



February 3, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface	2
How Soil Surveys Are Made	5
Soil Map	8
Soil Map.....	9
Legend.....	10
Map Unit Legend.....	11
Map Unit Descriptions.....	11
King County Area, Washington.....	13
EvB—Everett very gravelly sandy loam, 0 to 8 percent slopes.....	13
EvC—Everett very gravelly sandy loam, 8 to 15 percent slopes.....	14
EvD—Everett very gravelly sandy loam, 15 to 30 percent slopes.....	15
InA—Indianola loamy sand, 0 to 5 percent slopes.....	17
PITS—Pits.....	18
Sk—Seattle muck.....	19
Su—Sultan silt loam.....	20
References	22

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

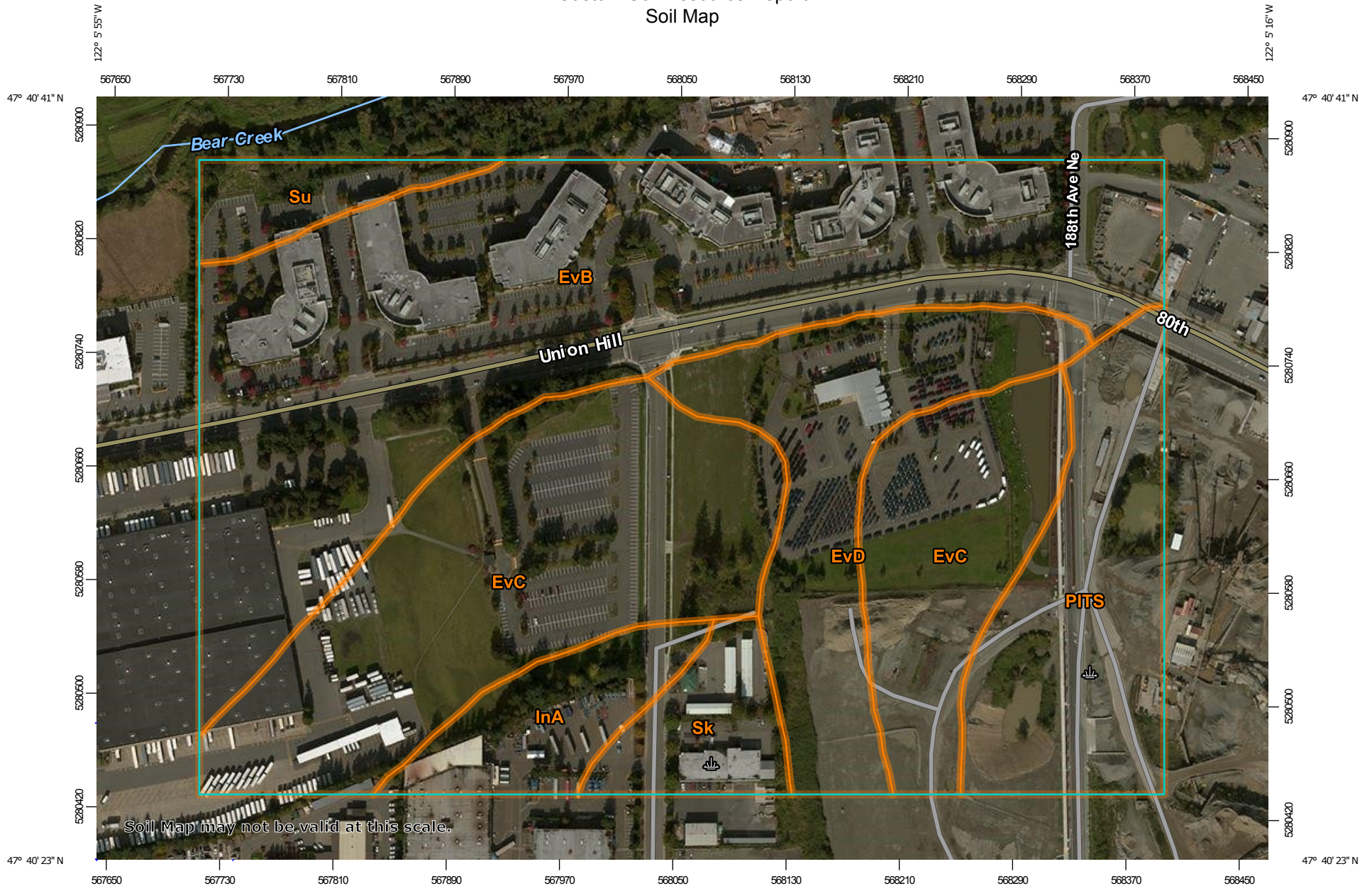
Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

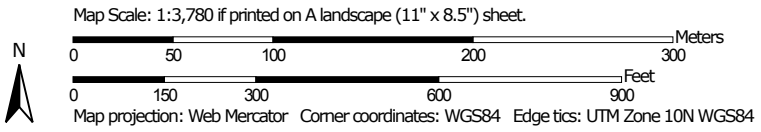
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map




Soil Map may not be valid at this scale.




MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)


Soils


 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip

 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals


Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington
Survey Area Data: Version 12, Sep 8, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 31, 2013—Oct 6, 2013

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

King County Area, Washington (WA633)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EvB	Everett very gravelly sandy loam, 0 to 8 percent slopes	28.1	37.2%
EvC	Everett very gravelly sandy loam, 8 to 15 percent slopes	22.0	29.1%
EvD	Everett very gravelly sandy loam, 15 to 30 percent slopes	8.7	11.5%
InA	Indianola loamy sand, 0 to 5 percent slopes	3.5	4.7%
PITS	Pits	8.4	11.1%
Sk	Seattle muck	2.8	3.8%
Su	Sultan silt loam	2.0	2.7%
Totals for Area of Interest		75.5	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not

mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

King County Area, Washington

EvB—Everett very gravelly sandy loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t629

Elevation: 30 to 900 feet

Mean annual precipitation: 35 to 91 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 180 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Eskers, moraines, kames

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Crest, interfluvium

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Sandy and gravelly glacial outwash

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material

A - 1 to 3 inches: very gravelly sandy loam

B_w - 3 to 24 inches: very gravelly sandy loam

C₁ - 24 to 35 inches: very gravelly loamy sand

C₂ - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (K_{sat}): High (1.98 to 5.95 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: A

Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XF403WA), Droughty Soils (G002XS401WA)

Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent
Landform: Ridges, hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Indianola

Percent of map unit: 10 percent
Landform: Eskers, kames, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

EvC—Everett very gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t62b
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Kames, eskers, moraines
Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: very gravelly sandy loam
Bw - 3 to 24 inches: very gravelly sandy loam
C1 - 24 to 35 inches: very gravelly loamy sand
C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA), Droughty Soils (G002XF403WA)
Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Indianola

Percent of map unit: 10 percent
Landform: Eskers, kames, terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

EvD—Everett very gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t62c
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent

Custom Soil Resource Report

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Kames, eskers, moraines

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

A - 1 to 3 inches: very gravelly sandy loam

Bw - 3 to 24 inches: very gravelly sandy loam

C1 - 24 to 35 inches: very gravelly loamy sand

C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: A

Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA)

Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent

Landform: Ridges, hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, nose slope, tal

Down-slope shape: Linear, convex

Across-slope shape: Convex

Hydric soil rating: No

Indianola

Percent of map unit: 10 percent

Landform: Eskers, kames, terraces

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

InA—Indianola loamy sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t62k
Elevation: 0 to 980 feet
Mean annual precipitation: 30 to 81 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Indianola and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Indianola

Setting

Landform: Eskers, kames, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 6 inches: loamy sand
Bw1 - 6 to 17 inches: loamy sand
Bw2 - 17 to 27 inches: sand
BC - 27 to 37 inches: sand
C - 37 to 60 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A

Custom Soil Resource Report

Other vegetative classification: Droughty Soils (G002XV402WA), Droughty Soils (G002XF403WA), Droughty Soils (G002XS401WA), Droughty Soils (G002XN402WA)

Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 8 percent

Landform: Ridges, hills

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest, tal

Down-slope shape: Linear, convex

Across-slope shape: Convex

Hydric soil rating: No

Everett

Percent of map unit: 5 percent

Landform: Kames, eskers, moraines

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Crest, interfluve

Down-slope shape: Convex

Across-slope shape: Convex

Hydric soil rating: No

Norma

Percent of map unit: 2 percent

Landform: Depressions, drainageways

Landform position (three-dimensional): Dip

Down-slope shape: Concave, linear

Across-slope shape: Concave

Hydric soil rating: Yes

PITS—Pits

Map Unit Composition

Pits: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8

Hydric soil rating: No

Sk—Seattle muck

Map Unit Setting

National map unit symbol: 1hmv4
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 250 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Seattle and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Seattle

Setting

Landform: Depressions
Parent material: Grassy organic material

Typical profile

H1 - 0 to 11 inches: muck
H2 - 11 to 60 inches: stratified mucky peat to muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 23.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Minor Components

Tukwila

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Shalcar

Percent of map unit: 10 percent
Landform: Depressions

Custom Soil Resource Report

Hydric soil rating: Yes

Bellingham

Percent of map unit: 3 percent

Landform: Depressions

Hydric soil rating: Yes

Norma

Percent of map unit: 2 percent

Landform: Depressions

Hydric soil rating: Yes

Su—Sultan silt loam

Map Unit Setting

National map unit symbol: 1hmv9

Elevation: 0 to 150 feet

Mean annual precipitation: 35 to 55 inches

Mean annual air temperature: 48 to 50 degrees F

Frost-free period: 150 to 200 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Sultan and similar soils: 70 percent

Minor components: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sultan

Setting

Landform: Flood plains

Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: ashy silt loam

H2 - 9 to 48 inches: silty clay loam

H3 - 48 to 60 inches: stratified sand to silt loam

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: About 24 to 36 inches

Frequency of flooding: Occasional

Frequency of ponding: None

Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w

Custom Soil Resource Report

Hydrologic Soil Group: C

Other vegetative classification: Seasonally Wet Soils (G002XN202WA)

Hydric soil rating: No

Minor Components

Puget

Percent of map unit: 10 percent

Landform: Flood plains

Hydric soil rating: Yes

Sammamish

Percent of map unit: 10 percent

Landform: Flood plains

Hydric soil rating: Yes

Oridia

Percent of map unit: 10 percent

Landform: Flood plains

Hydric soil rating: Yes

References

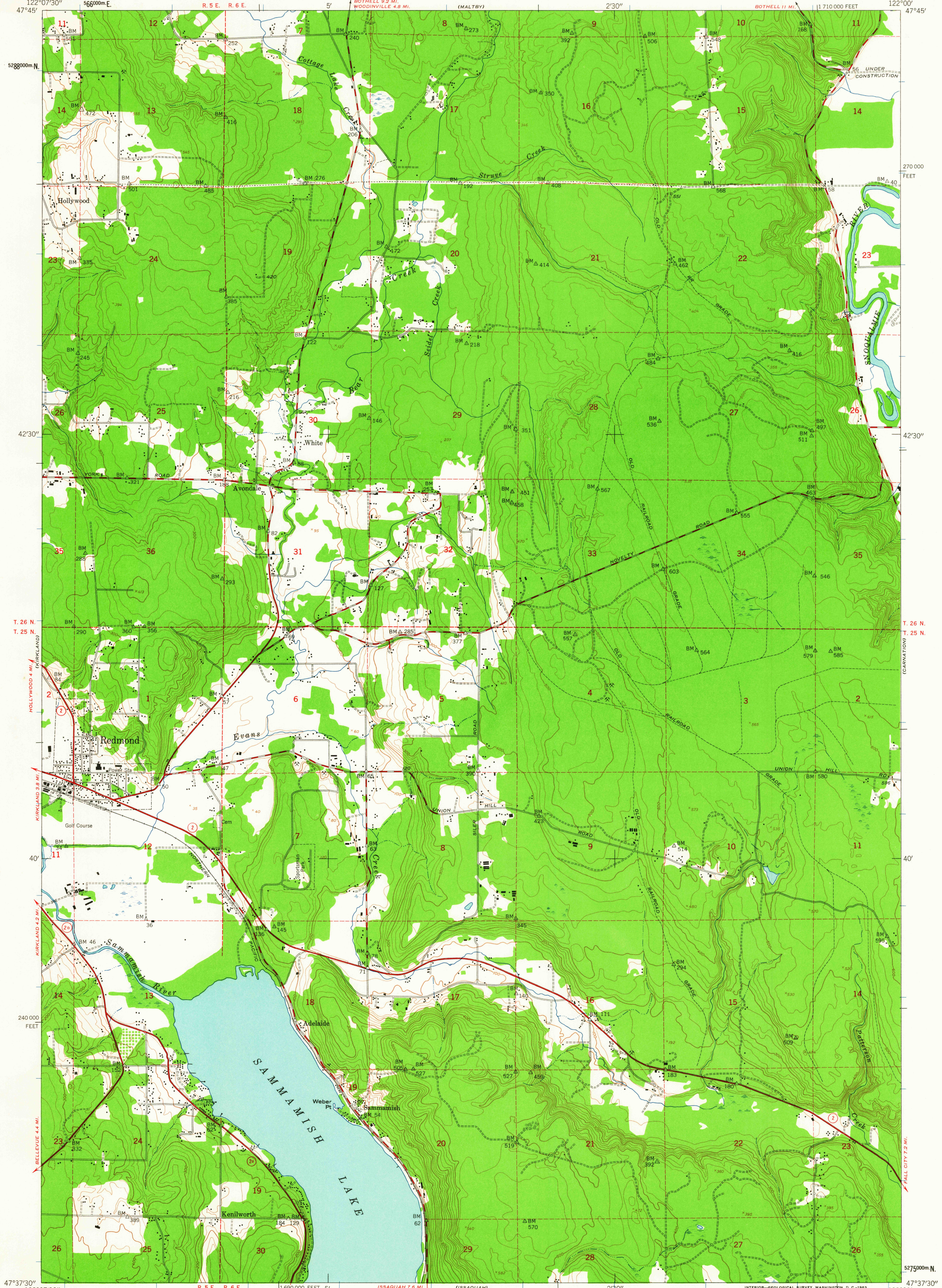
- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

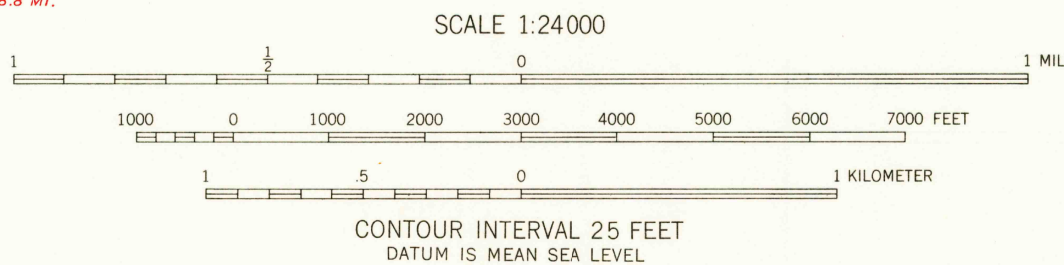
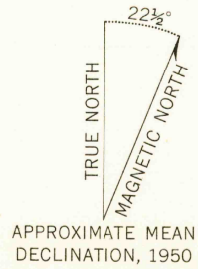
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Mapped by the Army Map Service
Published for civil use by the Geological Survey
Control by USC&GS and King County Engineer Office
Topography from aerial photographs by multiplex methods
Aerial photographs taken 1943. Field check 1950
Polyconic projection. 1927 North American datum
10,000-foot grid based on Washington coordinate system,
north zone
No distinction is made between barns, dwellings,
commercial and industrial buildings
Unchecked elevations are shown in brown
Dashed land lines indicate approximate locations
1000-meter Universal Transverse Mercator grid ticks,
zone 10, shown in blue



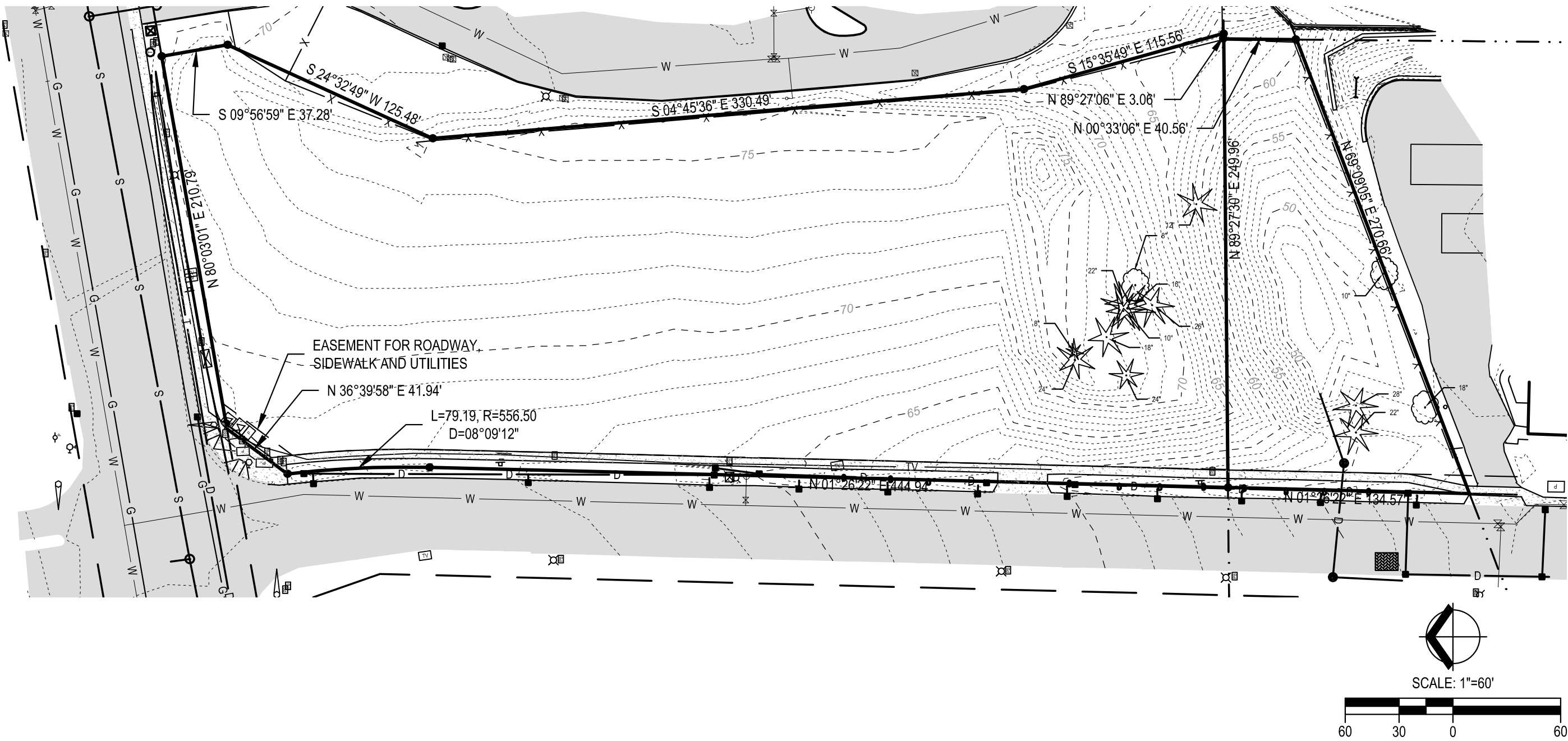
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 25, COLORADO OR WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



ROAD CLASSIFICATION
Heavy-duty ——— Light-duty ———
Medium-duty ——— Unimproved dirt ———
State Route

USGS
Historical File
Topographic Division
REDMOND, WASH.
N4737.5—W12200/7.5
1950

2970
DEC 12 1953



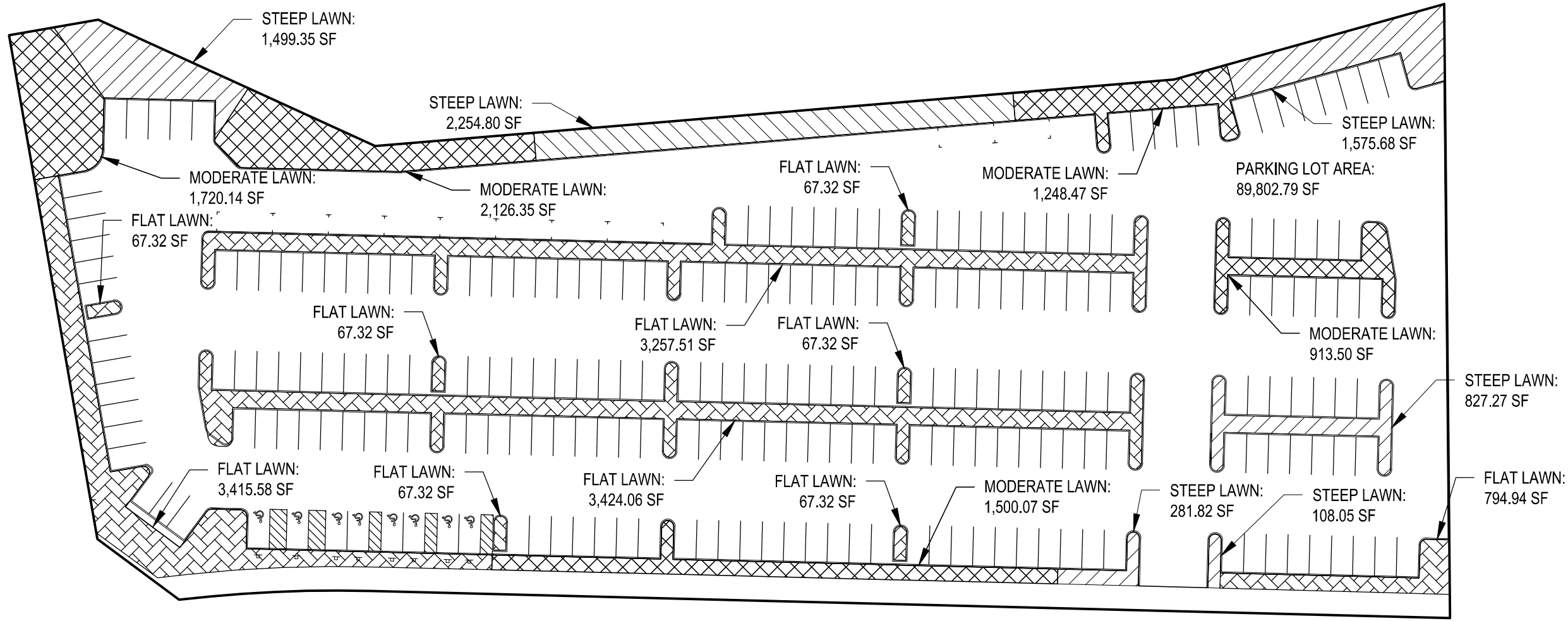
SITE DATA

- ACREAGE: 142,406 SQ.FT. (3.27 AC.)
- WELLHEAD PROTECTION ZONE 1
- WETLANDS: NONE MAPPED

PROJECT NO. 21612460
DATE: 11/16/2016
BY: LAG
SHEET NO. 1

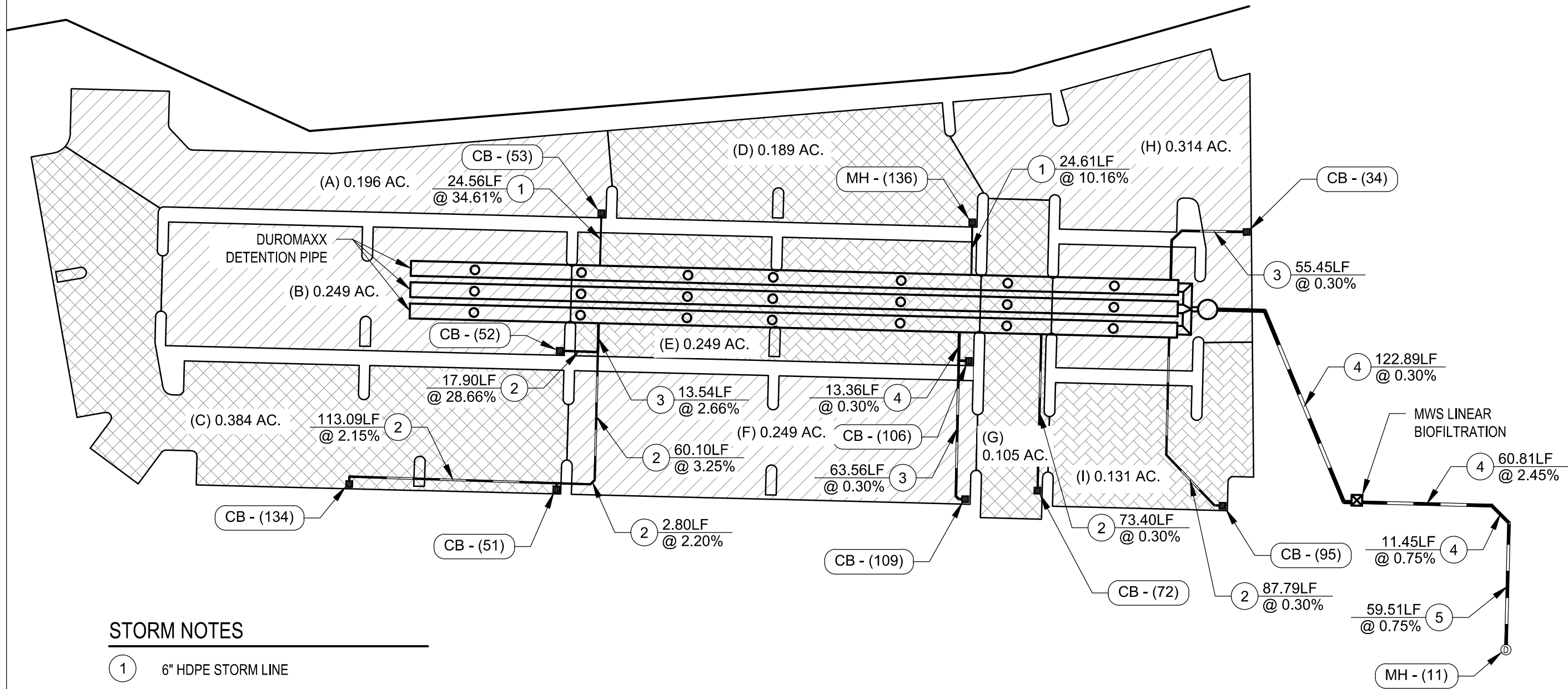
EXISTING CONDITIONS PLAN
UPS REDMOND PARKING EXPANSION

C2K ARCHITECTURE
REDMOND, WA



POST-DEVELOPED BASIN DELINEATION
UPS PARCEL DISTRIBUTION FACILITY

UNITED PARCEL SERVICE
REDMOND, WA



STORM NOTES

- ① 6" HDPE STORM LINE
- ② 8" HDPE STORM LINE
- ③ 10" HDPE STORM LINE
- ④ 12" HDPE STORM LINE
- ⑤ 12" PVC STORM LINE

GEOTECHNICAL ENGINEERING REPORT

Proposed New Parking Lot
18001 NE Union Hill Road
Redmond, WA

PSI PROJECT NO.07121335

February 25, 2016

Prepared for:

United Parcel Service
6177 N Basin Avenue
Portland, Oregon 97217

Prepared by:

Professional Service Industries, Inc.
20508 - 56th Ave W, Suite A
Lynnwood, WA 98036

February 25, 2016

United Parcel Service
6177 N Basin Avenue
Portland, Oregon, 97217

Attention: Buddy Dobberthein,
Project Engineer
odobberthein@ups.com
(360) 901-8236

Subject: Geotechnical Investigation
Proposed New Parking Lot
18001 NE Union Hill Road
Redmond, Washington
PSI Project # 07121335

Dear Mr. Dobberthein,

Professional Service Industries, Inc. (PSI) is pleased to submit a report of our geotechnical investigation for a new parking lot for United Parcel Service facility, in Redmond, Washington. This report summarizes the work accomplished and provides our recommendations for design and construction of the proposed project. PSI performed the requested geotechnical investigation services in general accordance with the design services agreement, dated January 21, 2016.

Based on the results of our field investigation, laboratory testing and engineering analysis, the proposed site is suitable for the construction of the proposed improvements from a geotechnical standpoint, provided the recommendations of this report are followed. Recommendations regarding the geotechnical aspects of project design and construction are presented in the attached report.

PSI appreciates the opportunity to contribute our services and looks forward to working with you during design and construction of this project. Please contact the undersigned directly if you have questions pertaining to this project.

Respectfully Submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.



Michael S. Place P.E.
Principal Consultant
Email: michael.place@psiusa.com
Phone: (425-409-2505)

Stephen R. Bryant, PE
Senior Vice President

1. PROJECT DESCRIPTION

PSI understands that United Parcel Service (UPS) is planning on constructing a parking lot on the southeast corner of the intersection of NE Union Hill road and 185th Avenue NE, in Redmond, Washington. As part of the new parking lot, a shallow infiltration system will be installed to handle the stormwater runoff from the new asphalt surfaces.

2. SITE DESCRIPTION

2.1. General

The site is located at 18001 NE Union Hill Road in Redmond, Washington. The site is bound by 185th Avenue NE to the west NE Union Hill Road to the north and commercial properties to the south and east. The site is currently covered by minor grasses and patches of exposed sand and gravel soil. Additionally, the site appears to have been excavated 10 feet in places during the expansion of 185th Avenue NE in 2011. This is based on observations made during our field investigation and on historical aerial imagery on Google Earth.

2.2. Topography

Based on our field investigation the site slopes gently down at approximately at 6 horizontal to 1 vertical from east to west towards 185th Avenue NE. Based on the nearby street and adjoining property elevations shown on Google Earth the site elevations appear to vary from 65 to 75 feet above mean sea level.

2.3. Geology

Based upon a review of Washington State Department of Natural Resources Interactive Maps (Reference 1) and the results of our field investigation the site is underlain by outwash deposits. Outwash typically consists of silts sands and gravels deposited by glacial meltwater. The nearest fault zone to the site is the Southern Whidbey Island Fault Zone approximately 4.5 miles north of the site. The Southern Whidbey Island Fault Zone trends northwest to southeast, is of unspecified age and has had no measurable movement recorded since initial monitoring of the fault (Reference 2).

2.4. Subsurface conditions

Subsurface materials and conditions were investigated with three soil borings and five infiltration test borings using hollow stem auger drilling techniques. Soil borings were designated B-1 through B-3 and Infiltration test borings were designated I-1 through I-5 were drilled on February 12, 2016. The three soil borings were drilled to depths of approximately 16½ feet below existing site grades (bgs) and the five infiltration test borings were drilled to approximately 3 feet bgs. The approximate locations of the soil and infiltration test borings are shown on Figure 2.

In general, the soils under the proposed parking lot areas generally consist of medium dense to dense poorly graded sand with silt and gravel and poorly graded gravel with sand. A detailed description of our field investigation and our boring logs are available in Appendix A. A description of the laboratory testing program along with sample test results are available in Appendix B. The terms used to describe material

encountered in the boring are defined in the General Notes, in Appendix A. A summary of the soils as they were encountered from the ground surface is provided below.

OUTWASH: The outwash soil consisted of brown poorly graded sand with gravel and poorly graded gravel with sand. Standard Penetration Test N-Values in the fill ranged from 11 to 55 blows per foot indicating the relative densities of medium dense to very dense soil. The existing moisture content of the fill ranges from 2 to 14 percent.

2.5. Groundwater

Groundwater was not observed onsite during our field investigation or after 24 hour readings obtained from the three soil boring locations. Based on observed groundwater noted in listed wells with the Department of Ecology (Reference 3), groundwater in this area was observed near an elevation of approximately 35 feet above mean sea level. Since site elevation appear to range from 65 to 75 feet above mean sea level, we anticipate that groundwater at the site is approximately 30 feet below the lowest elevation on the property. PSI anticipates that the groundwater table will fluctuate seasonally and in response to significant precipitation events and perched groundwater be present at shallower depths certain times of year.

2.6. Field Infiltration Testing

PSI performed five infiltration tests this investigation. These infiltration tests were conducted at the approximate depths of 3 feet bgs. Infiltration tests were conducted in shallow borings above the groundwater table in 4-inch inside diameter PVC pipes set in contact with the relatively undisturbed soil at the base of the boring. Native soils were then backfilled around the pipes. In the base of the pipe approximately 1-inch of washed pea gravel was placed in the base of the PVC pipe to prevent siltation during testing. In each boring PSI attempted to presoak the soils but the six-inch water column PSI attempted to maintain exited the infiltration test locations in less than 5 minutes and some drained out in a matter of seconds. After each attempted presoak PSI performed infiltration testing by adding a six-inch column of water into the boring and measuring the time required to drain the water out the base of the pipe. Infiltration tests were completed at least two times in each location. Percolation tests conducted in infiltration borings I-1 and I-2 were conducted in poorly-graded sand with gravel soils at their bases. Infiltration tests conducted in infiltration borings I-3, I-4 and I-5 pockets of clean gravel were observed in the base of the borings where infiltration testing was conducted. The Infiltration rates ranged from approximately 50 to over 100 inches per hour. The infiltration rates listed in this report are measured field infiltration rates and do not have a factor of safety applied to them. Infiltration rates are indicative of the soils at the specific location, depth and time in which they were conducted. Variations of any of these factor may alter the observed infiltration rates. Infiltration rates measured during our field investigation are shown in Table 1 below.

Table 1: Summary of Infiltration Rates

Infiltration ID	Infiltration Rate (in./hr)	Latitude	Longitude
I-1	50	47.67506	-122.09340
I-2	55	47.67587	-122.09342
I-3	>100	47.67600	-122.09342
I-4	>100	47.67652	-122.09287
I-5	>100	47.67575	-122.09304

3. CONCLUSIONS AND RECOMMENDATIONS

3.1. General

Subsurface explorations for this investigation indicate that the near surface soil on the site consist of medium dense poorly graded sand with silt and gravel. PSI believe the site is suitable for the specified improvements provided the recommendations stated in this report are followed.

3.2. Site Preparation

We anticipate that clearing and grubbing go the site will disturb approximately 3 to 4 inches of surface soils across the site. PSI further assumes that minor cuts and fills (less than 2 feet thick) will be required to regrade the site for the proposed parking lot.

3.3. Structural Fill

Fill placed beneath sidewalk, and pavement areas should be placed as compacted structural fill. We recommend that structural fill extends at least 2 feet beyond pavement limits where nearby structures do not restrict fill placement. On-site soils, outside of organic materials (such as topsoil) or other deleterious materials can be reused for backfill purposes, provided the material can obtain moisture contents that will allow it to meet compaction requirements. Imported material, if required, should be approved by the geotechnical engineer. Compacted fill should be placed in lifts of 12-inches (loose) or less by heavy compactors such as large vibratory rollers and hoe-packs and lifts of 6-inch (loose) or less for smaller compactors such as small plate compactors and jumping jacks. These soil should be moisture-conditioned to within 3 percent of the optimum moisture content, and compacted to a density of 95% of the maximum dry density as determined by ASTM D 1557.

The condition of the subgrade should be evaluated by a PSI representative before fill placement or construction begins. Fill compaction should be evaluated by in-place density tests performed during fill placement so that the adequacy of soil compaction efforts may be evaluated as earthwork progresses.

3.4. Utility Trench Excavations and Backfill

Excavations should be made in accordance with applicable Federal and State Occupational Safety and Health Administration regulations. Utility trenches in the near surface sand soils at the site will need to be slopes or shored from the ground surface due to the potential for caving. Actual inclinations will ultimately depend on the soil conditions encountered during earthwork. While we may provide certain approaches for trench excavations, the contractor should be responsible for selecting the excavation technique, monitoring the trench excavations for safety, and providing shoring, as required, to protect personnel and adjacent improvements. The information provided below is for use by the owner and engineer and should not be interpreted to mean that PSI is assuming responsibility for the contractor's actions or site safety. The soils PSI encountered within the upper 26 feet should be classified as Type C soil according to the most recent OSHA regulations. In our opinion, excavations should be safely sloped or shored. The contractor should be aware that excavation and shoring should conform to the requirements specified in the applicable local, state, and federal safety regulations, such as OSHA Health and Safety Standards for

Excavations, 29 CFR Part 1926, or successor regulations. We understand that such regulations are being strictly enforced, and if not followed, the contractor may be liable for substantial penalties.

Excavation and construction operations may expose the on-site soils to inclement weather conditions. The stability of exposed soils may deteriorate due to a change in moisture content or the action of heavy or repeated construction traffic. Accordingly, foundation and pavement area excavations should be protected from the elements and from the action of repetitive or heavy construction loadings.

Utilities trenches within the pavement, and sidewalk areas should be backfilled with granular structural fill such as sand, sand and gravel, crushed rock, or recycled concrete of up to 2 inches maximum size with less than 5 percent passing the No. 200 sieve (washed analysis). Granular backfill should be placed in lifts and compacted to 95 percent of the maximum dry density as determined by ASTM D 1557.

3.5. Pavement

We have made our design recommendations for new pavement sections assuming subgrade will be similar to the near-surface soils described in the boring logs. If the site soil conditions are different than those described in this report, we should be contacted so that we may confirm or modify the recommended pavement sections.

The soil type selected for the design subgrade consists of disturbed silty sand with gravel compacted to the requirements for structural fill outlined above. Based on our review of site soil conditions and the results of the California bearing ratio (CBR) testing, PSI has utilized a CBR value of 30 percent for our designs. This which is based on approximately 95% compaction.

The pavement section is dependent on the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. This parking lot is anticipated to cater small personal vehicles with only minor periods of time where heavier vehicles such as fire truck and bussed will enter the site. It should be recognized that standard pavement design methods are intended for through streets where accelerations are relatively low (i.e. velocities are relatively constant). Starting, stopping, and turning involve high accelerations. In these situations, the average daily traffic volume alone is insufficient to characterize the pavement loading. The Washington State Department of Transportation (WSDOT) Design Manual provides some guidance for designing pavement sections subjected to these higher accelerations.

As requested in the "Proposal Bid Package for Soil/Materials Engineering and Testing Services" provided by UPS for the Redmond Site, Dated December 16, 2015, PSI has prepared pavement design sections for 10-year and 20-year pavement section with overlay recommendation to make a 10-year pavement section into a 20-year pavement section, for Asphaltic Concrete (AC) with Crushed Rock Base (CRB), full depth AC, and Portland Cement Concrete (PCC) with CRB. PSI's designed pavement sections are listed in Table 2 Below.

Table 2: Pavement Design Sections

Pavement Life	ESAL's Used in Design	Type of Pavement	Layer Thicknesses (Inches)	
			AC	CRB
10-year	39500	AC and CRB	2	4
		Full Depth AC	3.5	-
		Concrete	4	4
Overlay to Make 10 year a 20 year	87500	AC and CRB	+1	-
		Full Depth AC	+1	-
		Concrete	-	-
20-year	87500	AC and CRB	2.5	4
		Full Depth AC	4	-
		Concrete	4	4

Paving materials used should conform to the specifications. We recommend that aggregate for AC should meet the Class ½-inch grading requirements specified in Section 9-03.8(6), aggregate for CRB should conform to Section 9-03.9(3) Top Course of Crushed Surfacing.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure because of surface water infiltrating into the subgrade soils and reducing their supporting capability. If practical, we recommend new pavements be placed with surface drainage gradients of at least two percent for better long-term performance. Some longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

New pavement sections must be installed over firm subgrade. This means that the top 12 inches of subgrade should be free of organics and other debris and compacted in conformance with our recommendations in section 3.3 (Structural Fill). Paving should be performed as soon as practical after subgrade preparations are completed. Pavement subgrade surfaces should be proof-rolled and re-compacted a second time with a heavy roller or equivalent immediately prior to constructing the pavement section if the prepared subgrade has been left unprotected for more than a few days or if it appears to have been disturbed from climatic conditions, excessive traffic, or other causes. We recommend that proof rolling be observed by a representative of the geotechnical engineer.

3.6. Drainage

We recommend pavement surfaces and open space areas be sloped such that surface water runoff is collected and routed to suitable discharge points. PSI recommends that any infiltration system used on this site be placed near the depth of the infiltration test performed for this investigation.

Our infiltration testing measured infiltration rates ranging from 50 to over 100 inches per hour. In our experience infiltration systems are not typically designed with rates exceeding 20 inches per hour, and as a

result we would recommend that the infiltration system be designed utilizing an infiltration rate of 20 inches per hour. This will allow for a factor of safety of at least 2.5 in the areas tested, but may not fully account of siltation of the designed infiltration system over time.

4. DESIGN REVIEW AND CONSTRUCTION MONITORING

We welcome the opportunity to review and discuss construction plans and specifications as they are being developed. We are of the opinion that to observe compliance with the design concepts, specifications, and recommendations, construction operations dealing with earthwork and pavement installation should be observed by a qualified geotechnical engineer. We would be pleased to provide these services to you.

5. REPORT LIMITATIONS

The recommendations submitted in this report are based on the subsurface information obtained by PSI and design details furnished by representatives of the client, United Parcels Service, for the proposed improvements at 18001 East Union Hill Road in Redmond, Washington. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation and/or pavement recommendations are required. If PSI is not retained to review these changes, PSI will not be responsible for the impact of those conditions on the project.

After the plans and specifications are more complete, PSI should be retained and provided the opportunity to review the final design plans and specifications to verify that our engineering recommendations have been properly incorporated into the design.

REFERENCES

Reference 1: Washington Department of Natural Resources Interactive Geologic Map,
http://www.dnr.wa.gov/researchscience/topics/geosciencesdata/pages/geology_portal.aspx

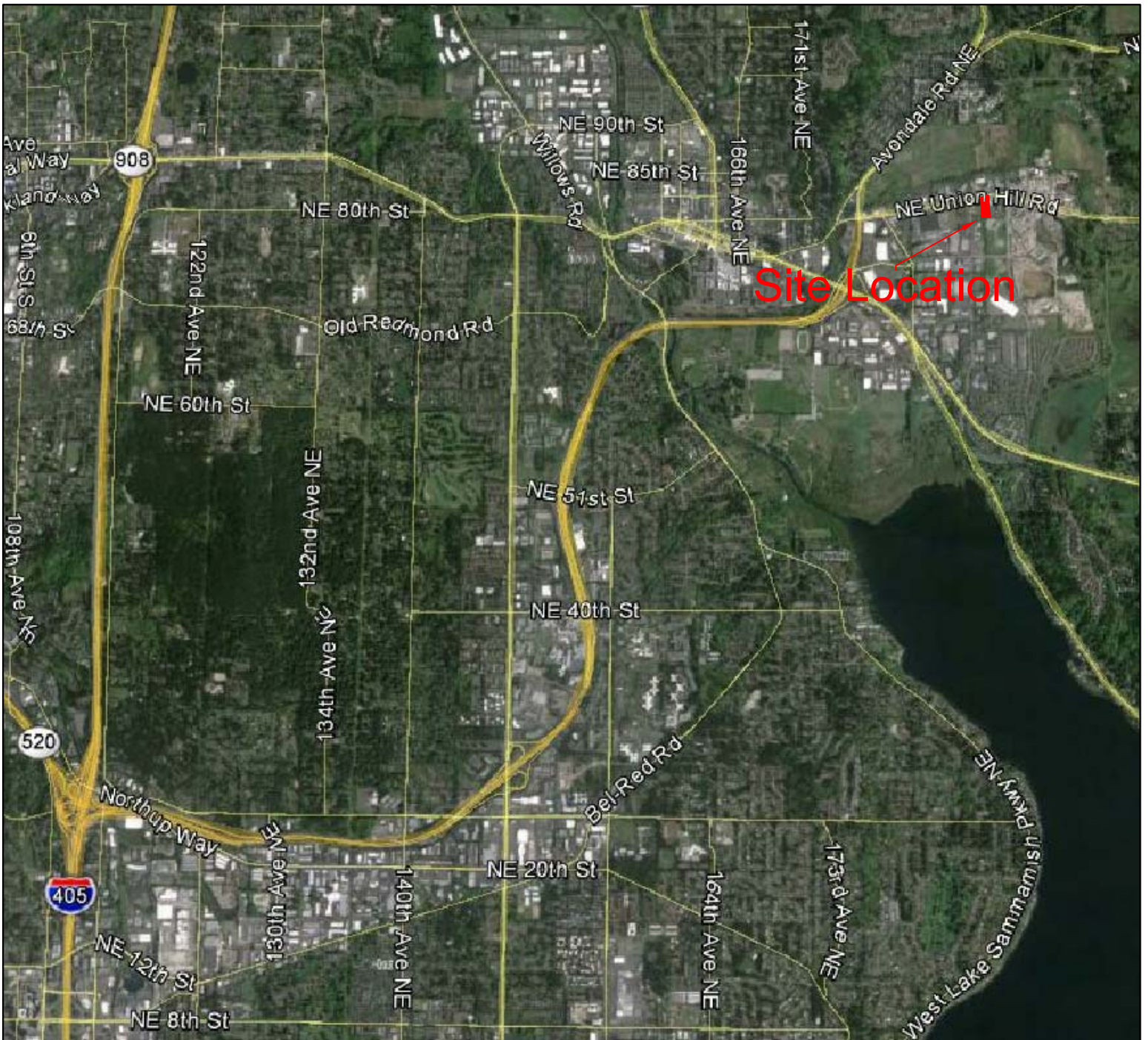
Reference 2: Sherrod, Brian L.; Blakely, Richard J.; Weaver, Craig S.; Kelsey, Harvey M.; Barnett, Elizabeth; Liberty, Lee; Meagher, Karen L.; Pape, Kristin, 2008, Finding concealed active faults--Extending the southern Whidbey Island fault across the Puget Lowland, Washington: Journal of Geophysical Research, v. 113,

Reference 3: Washington State Department of Ecology, Washington State Well Log Viewer,
<https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/WellConstructionMapSearch.aspx>

FIGURES

VICINITY MAP

SITE EXPLORATION LOCATION MAP



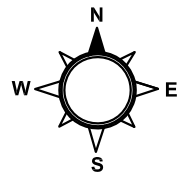
LEGEND:



= SITE LOCATION

NOTES

Site underlay provided by Google Earth



psi Information
To Build On
Engineering • Consulting • Testing

PROJECT NAME:
UPS Parking Lot
18001 NE Union Hill Road
Redmond, Washington

DRAWN BY:
MSP

DATE:
February, 2016

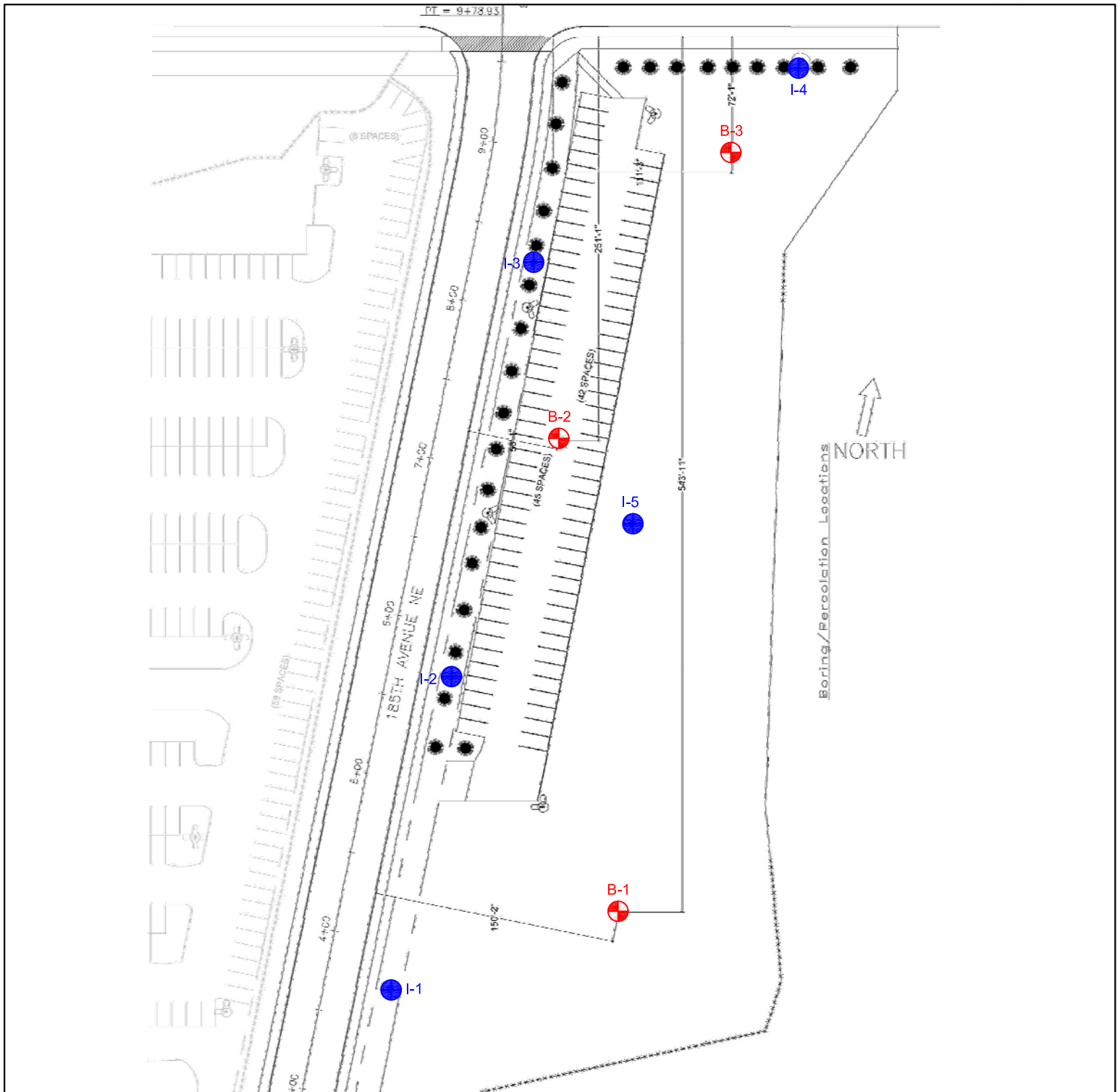
FIGURE:
1

20508 56th Ave W Suite A
Lynwood, WA 98036
(425)409-2504



DESCRIPTION:
Vicinity Map

APPROVED BY:
MSP

PSI PROJECT NUMBER:
07121335

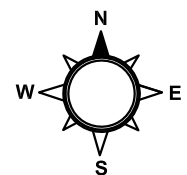


LEGEND:

-  Soil Boring Location
-  Infiltration Test Boring Location

NOTES

Site underlay provided by UPS



PSI Information
To Build On
Engineering • Consulting • Testing

PROJECT NAME:
UPS Parking Lot
18001 NE Union Hill Road
Redmond, Washington

DRAWN BY:
MSP

DATE:
February, 2016

FIGURE:
2

20508 56th Ave W Suite A
Lynwood, WA 98036
(425) 409-2504

DESCRIPTION:
Site Exploration Map

APPROVED BY:
MSP

PSI PROJECT NUMBER:
07121335

APPENDIX A

FIELD EXPLORATION PROGRAM

GENERAL NOTES

SOIL CLASSIFICATION CHART

BORING LOGS

FIELD EXPLORATION PROGRAM

General

We explored the site by drilling three soil borings (B-1 to B-3) to depths of approximately 16½ feet bgs and five infiltration test boring to a depth of approximately 3 feet using a trailer mounted drill rig, were advanced for this project. The locations of the borings and Soil and infiltration borings are shown on Figure 2. A representative of PSI's geotechnical staff was present during the explorations to record soil and groundwater conditions encountered in the exploration and to obtain soil samples for laboratory testing.

Sampling Procedures

Throughout the drilling operation, soil samples were obtained from the borings using a 2-inch OD Split Spoon in general conformance with guidelines presented in ASTM D1586, *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*. The samplers were driven into the soil a distance of 18 inches or to refusal with a 140-pound hammer free falling a distance of 30 inches. The sum of the blows required to drive the sampler in three 6-inch increments is provided in the boring logs. If the sampler met refusal, the number of inches driven and the number of blows is recorded. No sample are recovered from CPT's but data is available in this appendix.

The boring was drilled to observe the stratigraphy, density, and variability of subsurface soil conditions. Soil samples recovered from the explorations were sealed in airtight plastic jars to retain moisture and carefully transported to PSI's laboratory for additional examination and testing.

Field Classification

Soil samples were initially classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors and other distinguishing characteristics of the soil samples were noted. The terminology used in the soil and rock classifications and other modifiers are defined in the General Notes in this Appendix.

Exploration Logs

Summary boring log follows in this appendix. The left-hand portion of the boring log gives our interpretation of the soil encountered in the soil boring, sample locations and depths, and groundwater information. The right-hand portion of the log shows the results of the sample water contents, and other laboratory information.

The soil profile shown on the boring logs represent the conditions only at actual exploration location. Variations may occur and should be expected. The stratifications represent the approximate boundary between subsurface materials; the actual transition may be gradual.



GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.	SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
HSA: Hollow Stem Auger - typically 3 1/4" or 4 1/4" I.D. openings, except where noted.	ST: Shelby Tube - 3" O.D., except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry	BS: Bulk Sample
R.C.: Diamond Bit Core Sampler	PM: Pressuremeter
H.A.: Hand Auger	CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings
P.A.: Power Auger - Handheld motorized auger	

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N ₆₀ : A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q _u : Unconfined compressive strength, TSF
Q _p : Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL), %
DD: Dry unit weight, pcf
▼, ▼, ▼: Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS ANGULARITY OF COARSE-GRAINED PARTICLES

<u>Relative Density</u>	<u>N - Blows/foot</u>	<u>Description</u>	<u>Criteria</u>
Very Loose	0 - 4	Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Loose	4 - 10	Subangular:	Particles are similar to angular description, but have rounded edges
Medium Dense	10 - 30	Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Dense	30 - 50	Rounded:	Particles have smoothly curved sides and no edges
Very Dense	50 - 80		
Extremely Dense	80+		

GRAIN-SIZE TERMINOLOGY

<u>Component</u>	<u>Size Range</u>
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (3/4 in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to 3/4 in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

<u>Description</u>	<u>Criteria</u>
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%



GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

<u>Q_u - TSF</u>	<u>N - Blows/foot</u>	<u>Consistency</u>
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Medium Stiff
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

<u>Description</u>	<u>Criteria</u>
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

<u>Description</u>	<u>Criteria</u>	<u>Description</u>	<u>Criteria</u>
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick	Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick	Lensed:	Inclusion of small pockets of different soils
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing	Layer:	Inclusion greater than 3 inches thick (75 mm)
Slickensided:	Fracture planes appear polished or glossy, sometimes striated	Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
		Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

<u>Q_u - TSF</u>	<u>Consistency</u>
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

<u>Description</u>	<u>Criteria</u>
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

<u>Voids</u>	<u>Void Diameter</u>
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)	
<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

<u>Rock Mass Description</u>	<u>RQD Value</u>
Excellent	90 - 100
Good	75 - 90
Fair	50 - 75
Poor	25 - 50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
		HIGHLY ORGANIC SOILS			PT





Professional Service Industries, Inc.
20508 56th Avenue W, Suite A
Lynnwood, WA 98036
Telephone: (425) 409-2504
Fax: (425) 582-8193

LOG OF BORING B-1

Sheet 1 of 1

PSI Job No.: 07121335
Project: UPS
Location: 18001 NE Union Hill Rd
Redmond, WA

Drilling Method: Hollow Stem Auger
Sampling Method: SS
Hammer Type: Manual Pulley
Boring Location:

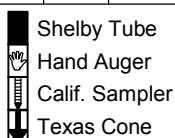
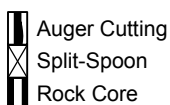
WATER LEVELS



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	Station: N/A Offset: N/A MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, % STRENGTH, tsf	Additional Remarks
	0					Poorly-graded SAND with silt and gravel: dark brown, moist, nonplastic, with organics (topsoil)		6-8-7 N=15		
					3	Poorly graded SAND with silt and gravel: moist, brown, medium dense, nonplastic, rounded to sub rounded gravel, sub rounded sand	SP-SM	5-5-6 N=11		
	5				11			5-5-7 N=12		
					13	Poorly graded GRAVEL with sand: moist, brown, dense, nonplastic,	GP	9-13-17 N=30		
	10				9			16-28-27 N=55		
					8	Poorly-graded SAND with gravel: moist, brown, dense, nonplastic, rounded to sub rounded gravel, sub rounded sand	SP	7-14-25 N=39		
	15				4	Bottom of boring at 16 ft 6 inches. No ground water observed.				

Completion Depth: 15.0 ft
Date Boring Started: 2/12/16
Date Boring Completed: 2/12/16
Logged By: Sunia Malolo
Drilling Contractor: Geologic Drill

Sample Types:



Latitude: 47.67547°
Longitude: -122.09304°
Drill Rig: Trailer Mounted
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



Professional Service Industries, Inc.
20508 56th Avenue W, Suite A
Lynnwood, WA 98036
Telephone: (425) 409-2504
Fax: (425) 582-8193

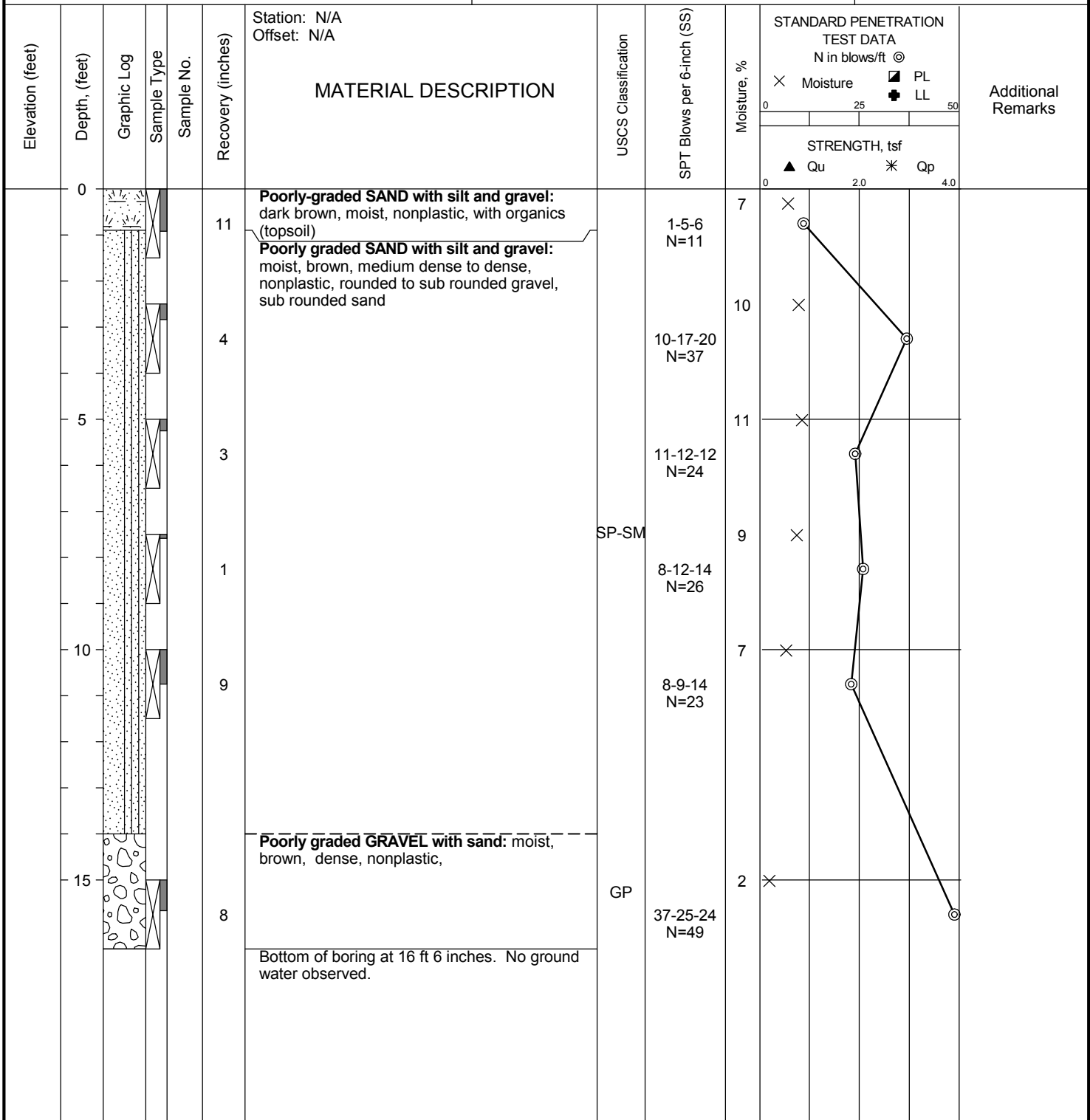
LOG OF BORING B-2

Sheet 1 of 1

PSI Job No.: 07121335
Project: UPS
Location: 18001 NE Union Hill Rd
Redmond, WA

Drilling Method: Hollow Stem Auger
Sampling Method: SS
Hammer Type: Manual Pulley
Boring Location:

WATER LEVELS



Completion Depth: 15.0 ft
Date Boring Started: 2/12/16
Date Boring Completed: 2/12/16
Logged By: Sunia Malolo
Drilling Contractor: Geologic Drill

Sample Types:

	Auger Cutting		Shelby Tube
	Split-Spoon		Hand Auger
	Rock Core		Calif. Sampler
			Texas Cone

Latitude: 47.67643°
Longitude: -122.09301°
Drill Rig: Trailer Mounted
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.



Professional Service Industries, Inc.
20508 56th Avenue W, Suite A
Lynnwood, WA 98036
Telephone: (425) 409-2504
Fax: (425) 582-8193

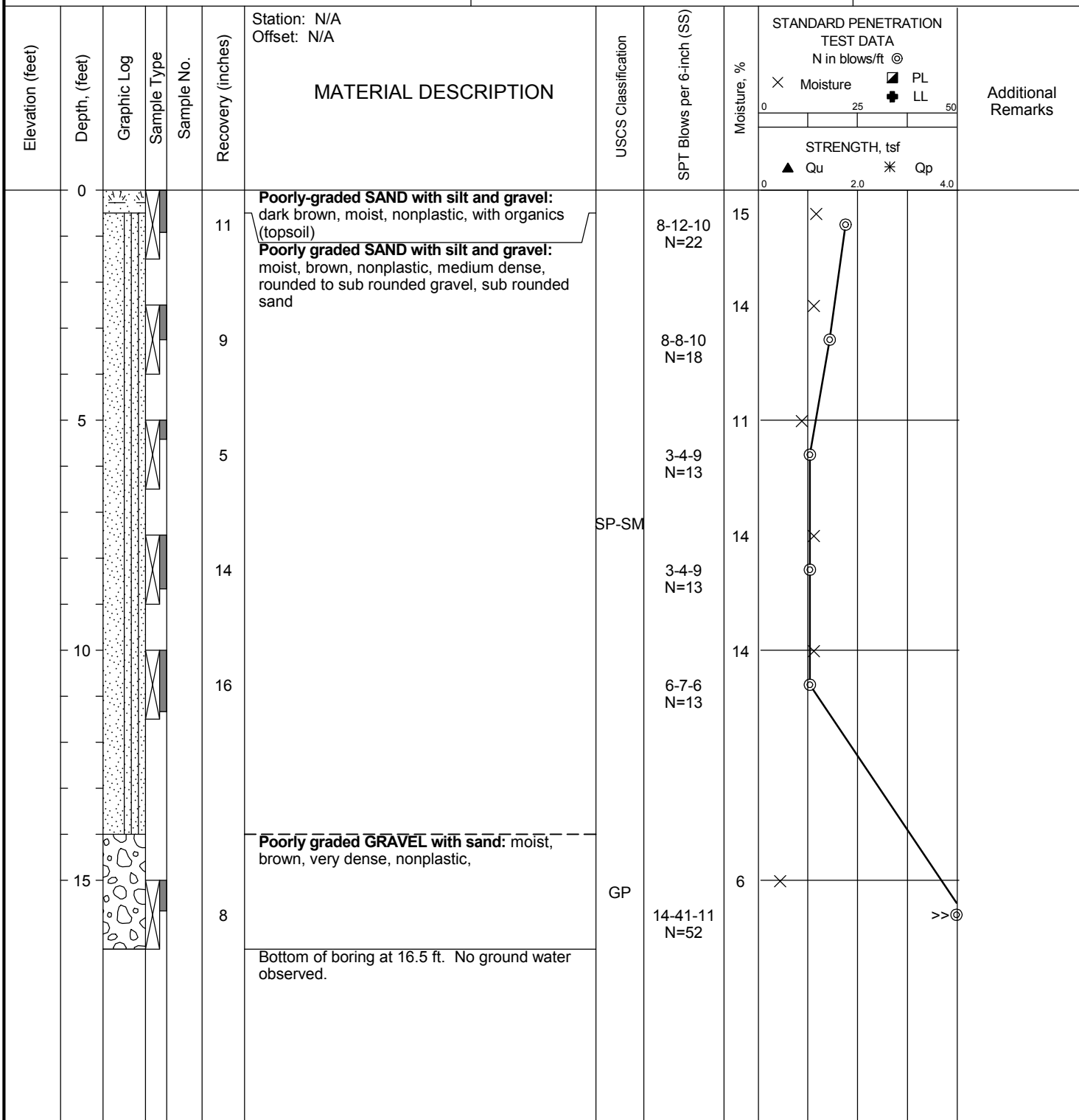
LOG OF BORING B-3

Sheet 1 of 1

PSI Job No.: 07121335
Project: UPS
Location: 18001 NE Union Hill Rd
Redmond, WA

Drilling Method: Hollow Stem Auger
Sampling Method: SS
Hammer Type: Manual Pulley
Boring Location:

WATER LEVELS




Completion Depth: 15.0 ft
Date Boring Started: 2/12/16
Date Boring Completed: 2/12/16
Logged By: Sunia Malolo
Drilling Contractor: Geologic Drill








Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude: 47.67591°
Longitude: -122.09319°
Drill Rig: Trailer Mounted
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

PSI Job No.: 07121335	Drilling Method: Hollow Stem Auger	<div>WATER LEVELS</div> <div>▽</div> <div>▼</div> <div>▼</div>
Project: UPS	Sampling Method:	
Location: 18001 NE Union Hill Rd Redmond, WA	Hammer Type: Boring Location:	

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⓘ				Additional Remarks
									×	Moisture	■ PL	⊕ LL	
									0	25	50		
									STRENGTH, tsf				
									▲ Qu	✱ Qp			
	0					<p>Poorly-graded SAND with silt and gravel: dark brown, moist, nonplastic, with organics (topsoil)</p> <p>Poorly graded SAND with silt and gravel: moist, brown, nonplastic, rounded to sub rounded gravel, sub rounded sand</p> <p>Bottom boring 3 feet. No groundwater observed</p>	SP-SM						

Completion Depth:	3.0 ft	Sample Types:	 Shelby Tube	Latitude: 47.67506°
Date Boring Started:	2/12/16	 Auger Cutting	 Hand Auger	Longitude: -122.0934°
Date Boring Completed:	2/12/16	 Split-Spoon	 Calif. Sampler	Drill Rig: Trailer Mounted
Logged By:	Sunia Malolo	 Rock Core	 Texas Cone	Remarks:
Drilling Contractor:	Geologic Drill			

The stratification lines represent approximate boundaries. The transition may be gradual.










LOG OF BORING I-2




Sheet 1 of 1

PSI Job No.: 07121335	Drilling Method: Hollow Stem Auger	<div>WATER LEVELS</div> <div>▽</div> <div>▼</div> <div>▼</div>
Project: UPS	Sampling Method:	
Location: 18001 NE Union Hill Rd Redmond, WA	Hammer Type: Boring Location:	








[illegible]

Completion Depth:	3.0 ft	Sample Types:	 Shelby Tube	Latitude: 47.67587°
Date Boring Started:	2/12/16	 Auger Cutting	 Hand Auger	Longitude: -122.09342°
Date Boring Completed:	2/12/16	 Split-Spoon	 Calif. Sampler	Drill Rig: Trailer Mounted
Logged By:	Sunia Malolo	 Rock Core	 Texas Cone	Remarks:
Drilling Contractor:	Geologic Drill			

The stratification lines represent approximate boundaries. The transition may be gradual.

PSI Job No.: 07121335	Drilling Method: Hollow Stem Auger	<div style="text-align: center;"> WATER LEVELS    </div>
Project: UPS	Sampling Method:	
Location: 18001 NE Union Hill Rd Redmond, WA	Hammer Type: Boring Location:	

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⓘ × Moisture ▣ PL + LL				Additional Remarks
	0								STRENGTH, tsf ▲ Qu ✱ Qp				
						<p>Poorly-graded SAND with silt and gravel: dark brown, moist, nonplastic, with organics (topsoil)</p> <p>Poorly graded SAND with silt and gravel: moist, brown, nonplastic, rounded to sub rounded gravel, sub rounded sand. Pocket of clean gravel observed near base.</p> <p>Bottom boring 3 feet. No groundwater observed</p>	SP-SM						

Completion Depth:	3.0 ft	Sample Types:	 Shelby Tube  Hand Auger  Calif. Sampler  Texas Cone	Latitude: 47.646°
Date Boring Started:	2/12/16	 Auger Cutting  Split-Spoon  Rock Core		Longitude: -122.09342°
Date Boring Completed:	2/12/16			Drill Rig: Trailer Mounted
Logged By:	Sunia Malolo			Remarks:
Drilling Contractor:	Geologic Drill			

The stratification lines represent approximate boundaries. The transition may be gradual.





APPENDIX B

LABORATORY TESTING PROGRAM

LABORATORY TEST RESULTS

Laboratory Testing Program and Procedures

General

Soil samples obtained during the field explorations were examined in our laboratory. The physical characteristics of the samples were noted and the field classifications were modified where necessary in accordance with terminology presented the General Notes included in this appendix.

Representative samples were selected during the course of the examination for further testing. The testing procedures and results of the tests are summarized below. The phrase "In general accordance with guidelines presented in..." means that certain local and common descriptive practices and methodologies have been followed.

Visual-Manual Classification

The soil samples were classified in general accordance with guidelines presented in ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. Certain terminology incorporating current local engineering practice, as provided in the Soil Classification Chart included with or in lieu of ASTM terminology. The term which best described the major portion of the sample was used in determining the soil type (that is, gravel, sand, silt or clay).

Moisture Content

Natural moisture content determinations were made on all samples. The natural moisture content is defined as the ratio of the weight of water to dry weight of soil, expressed as a percentage. The results of the moisture content determinations are presented on the boring logs in this appendix.

Grain Size Analysis

Select samples from the borings were analyzed for grain size in general conformance with ASTM C 136 and ASTM C117. In general, samples were oven dried, weighed then washed over a #200 sieve to remove silt and clay sized particles and then dried again. The samples were separated through a series of sieves of progressively smaller openings for determination of particle size distribution. The material passing and/or retained on each sieve was recorded as a percent of the total sample weight. The results of the sieve analysis are depicted in this Appendix.

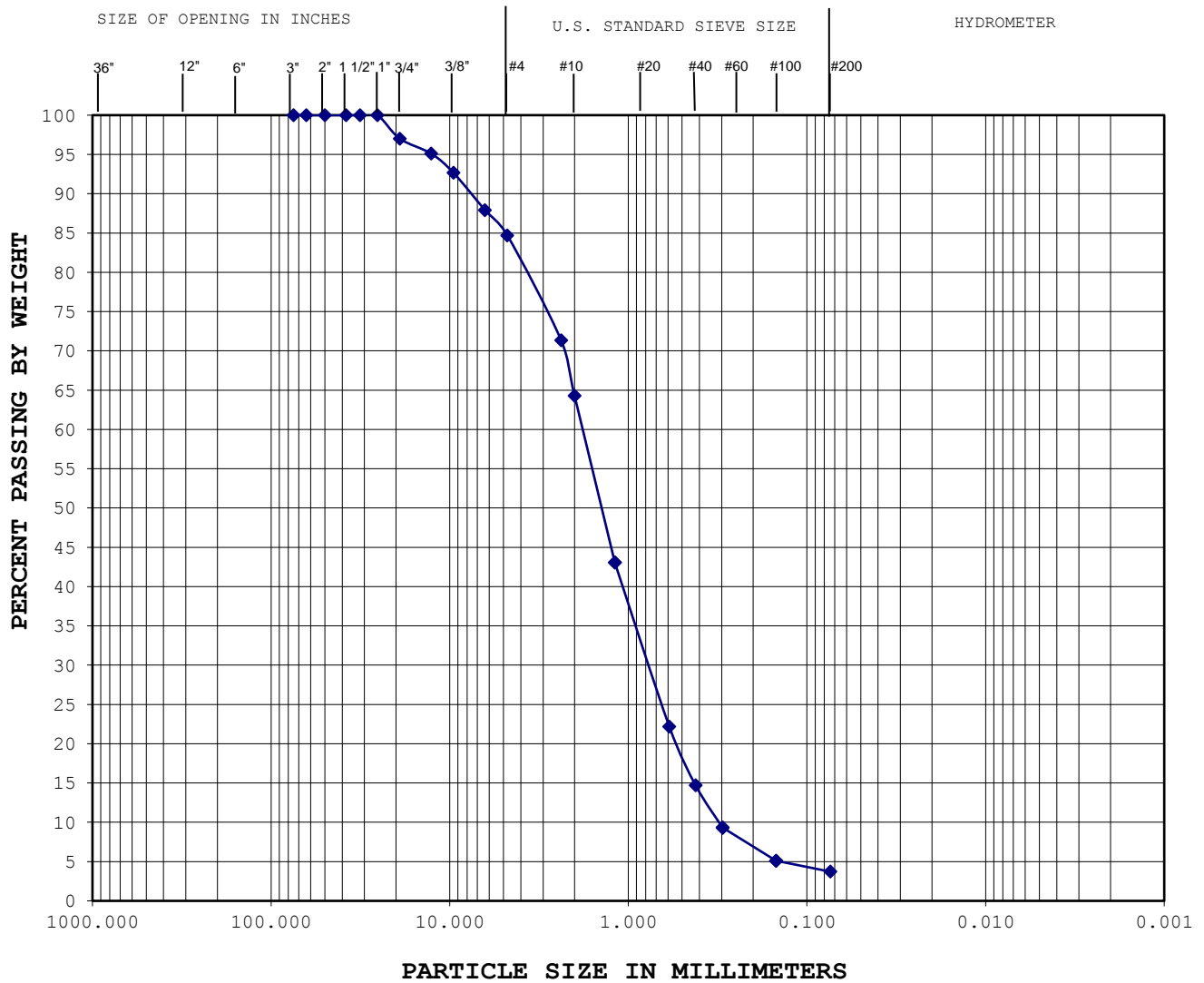
California Bearing Ratio (CBR)

The CBR (ASTM D4429), involve compacting a sample material into several molds at various levels of compaction and saturating them for a period of 96 hours. After saturation the material is placed into a machine that forces a two-inch diameter rod into the soil measurements of the depth of embedment and force exerted on the soil to penetrate the soil to these depths are recorded and then plotted to determine the CBR value at various levels of compactive effort.

Modified Proctor

A sample of soil was analyzed using moisture density test ASTM D1557. The test involves compacting soil into a four or six-inch diameter mold using a ten-pound hammer falling 18 inches for specified number of times in five lifts. The test is rerun at multiple moisture contents and the densities and moisture contents are plotted to determine the maximum dry density and moisture content of the material.

PARTICLE SIZE ANALYSIS - ASTM C136/C117



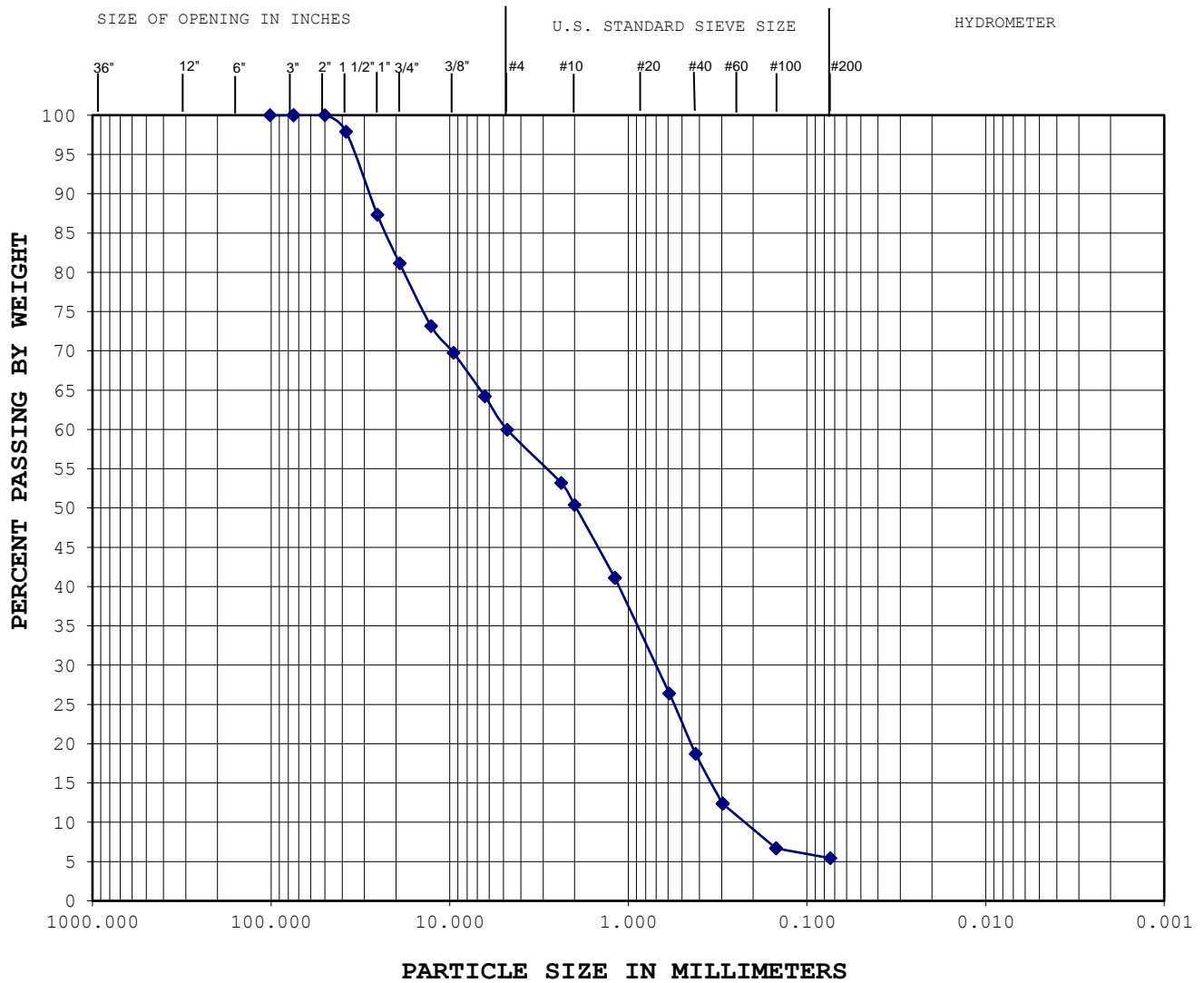
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
BOULDERS	COBBLES	GRAVEL		SAND			FINE GRAINED	

% Gravel	% Sand	% Fines	PL = NP
15.3%	81.0%	3.7%	LL = NP
Soil Classification			PI = NP
Poorly Graded SAND with Gravel			

Exploration	Sample	Depth (feet)	Moisture	Reviewed	USCS Symbol
B-1		5 feet	7.6	MSP	SP

	PROJECT NO:	PROJECT NAME:
	07121235	UPS, Redmond


PARTICLE SIZE ANALYSIS - ASTM C136/C117



BOULDERS	COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		GRAVEL		SAND			FINE GRAINED	

% Gravel	% Sand	% Fines	PL = NP
40.0%	54.5%	5.4%	LL = NP
Soil Classification			PI = NP
Poorly Graded SAND with Silt and Gravel			

Exploratio	Sample	Depth	Moisture	Reviewed	USCS Symbol
Composite B-1, B-2		Cuttings 0.5-3 feet	2.3	MSP	SP-SM

 Information To Build On Engineering • Consulting • Testing	PROJECT NO:	PROJECT NAME:
	07121335	UPS, Redmond

California Bearing Ratio Report

Report No: CBR:07121335-1-S2

Issue No: 1

Client: UNITED PARCEL SERVICE
6707 NORTH BASIN AVENUE
PORTLAND, OR 97217

CC:

Project: UPS PARKING LOT REDMOND

These test results apply only to the specific locations and materials noted and may not represent any other locations or elevations. This report may not be reproduced, except in full, without written permission by Professional Service Industries, Inc. If a non-compliance appears on this report, to the extent that the reported non-compliance impacts the project, the resolution is outside the PSI scope of engagement.



Approved Signatory: Michael Place (Project Engineer)
Date of Issue: 2/24/2016

Sample Details

Sample ID: 07121335-1-S2

Date Sampled: 1/27/2016

Sampling Method:

Source:

Material:

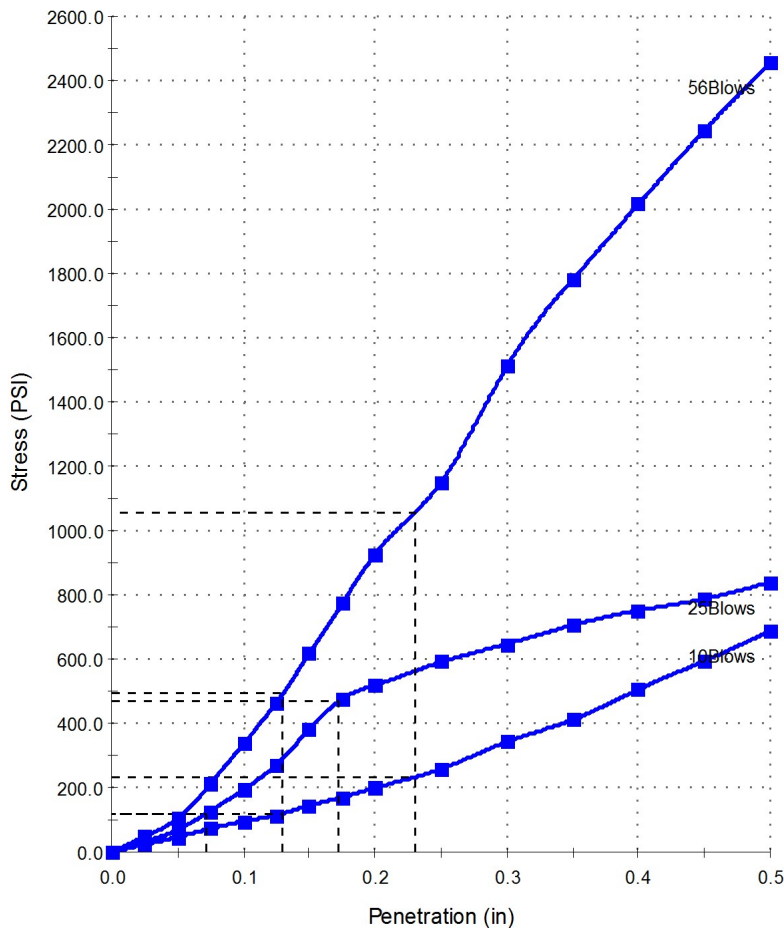
Specification:

Location:

Tested By: (unknown)

Date Tested:

Stress vs Penetration



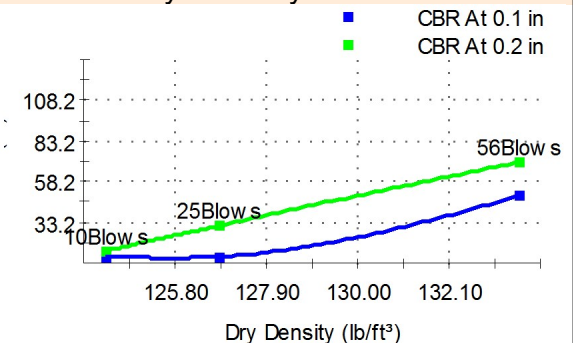
Overall Results

ASTM D 1883

Test Results

Blows	10	25	56
Comp. Eff.	ASTM D 1557	ASTM D 1557	ASTM D 1557
Initial MC (%)	8.9	9.3	8.8
MC of Top 1in (%)	8.9	9.3	8.8
MC After (%)	8.9	9.3	8.8
DD Before (lb/ft³)	124.20	126.81	133.68
DD After (lb/ft³)	124.20	126.32	135.04
CBR (%)	15.5	31.2	70.3
% MDD	92.8	94.8	99.9
Sample Condition	soaked	soaked	soaked
Surcharge (lb)			
Swell (%)			
Oversize (%)			

CBR Vs Dry Density



Comments



Professional Service Industries, Inc.
20508 56th Avenue, Suite A
Lynnwood, WA 98036

Phone: (425) 409-2504
Fax: (425) 582-8193

Proctor Report

Report No: PTR:07121335-1-S2

Issue No: 1

Client: UNITED PARCEL SERVICE
6707 NORTH BASIN AVENUE
PORTLAND, OR 97217

CC:

These test results apply only to the specific locations and materials noted and may not represent any other locations or elevations. This report may not be reproduced, except in full, without written permission by Professional Service Industries, Inc. If a non-compliance appears on this report, to the extent that the reported non-compliance impacts the project, the resolution is outside the PSI scope of engagement.

Project: UPS PARKING LOT REDMOND

Approved Signatory: Michael Place (Project Engineer)
Date of Issue: 2/24/2016

Sample Details

Sample ID: 07121335-1-S2

Date Sampled: 1/27/2016

Sampled By: Michael Place

Specification: no specifications

Material:

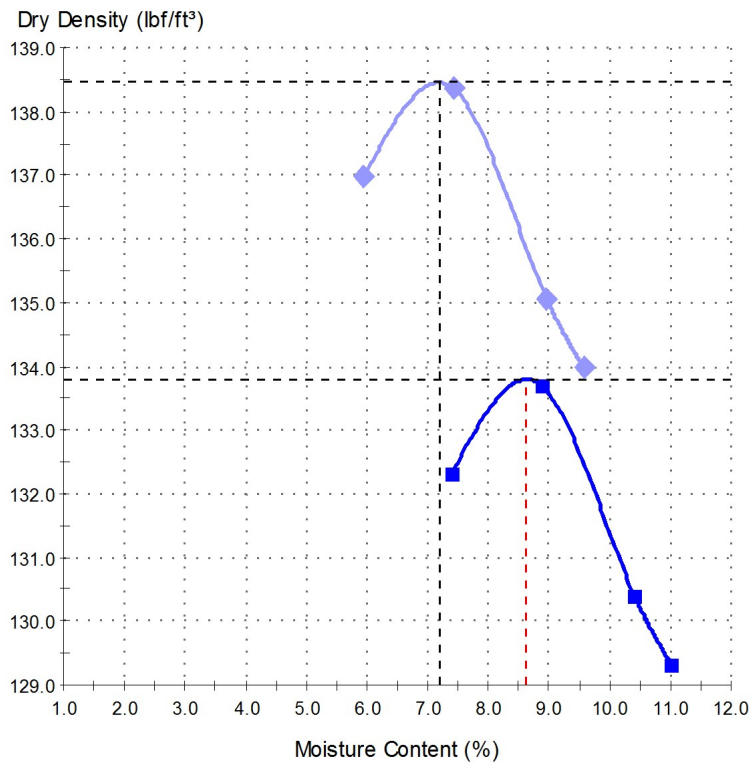
Sampling Method:

Location:

Tested By: (unknown)

Dry Density - Moisture Content Relationship

■ Uncorrected ◆ Corrected



Test Results

ASTM D 1557

Maximum Dry Density (lb/ft³):	133.8
Optimum Moisture Content (%):	8.6
Method:	C
Preparation Method:	
Retained Sieve 3/8" (9.5mm) (%):	47
Retained Sieve 3/4" (19mm) (%):	18
Passing Sieve 3/8" (9.5mm) (%):	53
Passing Sieve 3/4" (19mm) (%):	82
Specific Gravity (Oversize):	2.64

ASTM D 4718

Corrected Maximum Dry Density (lb/ft³):	138.5
Corrected Optimum Moisture Content (%):	7.2

Comments

WWHM2012
PROJECT REPORT

General Model Information

Project Name: UPS REDMOND
Site Name:
Site Address:
City:
Report Date: 2/1/2017
Gage: Seatac
Data Start: 1948/10/01
Data End: 2009/09/30
Timestep: 15 Minute
Precip Scale: 1.00
Version Date: 2016/02/25
Version: 4.2.12

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass: No

GroundWater: No

Pervious Land Use acre

C, Forest, Mod 1.32

C, Forest, Steep 1.32

Pervious Total 2.64

Impervious Land Use acre

Impervious Total 0

Basin Total 2.64

Element Flows To:

Surface

Interflow

Groundwater

Mitigated Land Use

Basin 1

Bypass: No

GroundWater: No

Pervious Land Use acre

C, Lawn, Flat 0.27

C, Lawn, Mod 0.17

C, Lawn, Steep 0.15

Pervious Total 0.59

Impervious Land Use acre

PARKING MOD 2.06

Impervious Total 2.06

Basin Total 2.65

Element Flows To:

Surface
Vault 1

Interflow
Vault 1

Groundwater

Routing Elements

Predeveloped Routing

Mitigated Routing

Vault 1

Width: 81.8916843467132 ft.
Length: 81.8916843467132 ft.
Depth: 6.89 ft.
Discharge Structure
Riser Height: 5.89 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.03 in. Elevation:0 ft.
Orifice 2 Diameter: 1.55 in. Elevation:3.53863 ft.
Orifice 3 Diameter: 0.93 in. Elevation:4.0275 ft.
Element Flows To:
Outlet 1 Outlet 2

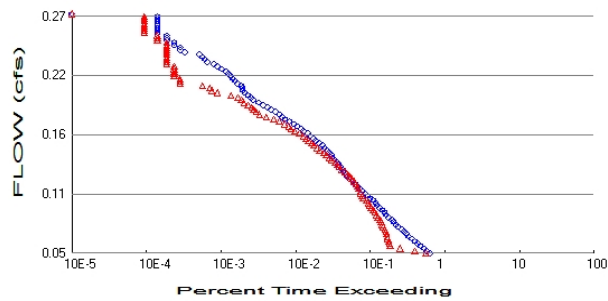
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.154	0.000	0.000	0.000
0.0766	0.154	0.011	0.008	0.000
0.1531	0.154	0.023	0.011	0.000
0.2297	0.154	0.035	0.013	0.000
0.3062	0.154	0.047	0.015	0.000
0.3828	0.154	0.058	0.017	0.000
0.4593	0.154	0.070	0.019	0.000
0.5359	0.154	0.082	0.021	0.000
0.6124	0.154	0.094	0.022	0.000
0.6890	0.154	0.106	0.023	0.000
0.7656	0.154	0.117	0.025	0.000
0.8421	0.154	0.129	0.026	0.000
0.9187	0.154	0.141	0.027	0.000
0.9952	0.154	0.153	0.028	0.000
1.0718	0.154	0.165	0.029	0.000
1.1483	0.154	0.176	0.030	0.000
1.2249	0.154	0.188	0.031	0.000
1.3014	0.154	0.200	0.032	0.000
1.3780	0.154	0.212	0.033	0.000
1.4546	0.154	0.223	0.034	0.000
1.5311	0.154	0.235	0.035	0.000
1.6077	0.154	0.247	0.036	0.000
1.6842	0.154	0.259	0.037	0.000
1.7608	0.154	0.271	0.038	0.000
1.8373	0.154	0.282	0.039	0.000
1.9139	0.154	0.294	0.039	0.000
1.9904	0.154	0.306	0.040	0.000
2.0670	0.154	0.318	0.041	0.000
2.1436	0.154	0.330	0.042	0.000
2.2201	0.154	0.341	0.042	0.000
2.2967	0.154	0.353	0.043	0.000
2.3732	0.154	0.365	0.044	0.000
2.4498	0.154	0.377	0.045	0.000
2.5263	0.154	0.388	0.045	0.000
2.6029	0.154	0.400	0.046	0.000
2.6794	0.154	0.412	0.047	0.000
2.7560	0.154	0.424	0.047	0.000
2.8326	0.154	0.436	0.048	0.000

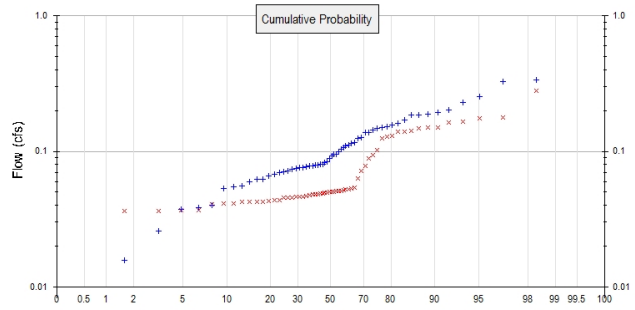
2.9091	0.154	0.447	0.049	0.000
2.9857	0.154	0.459	0.049	0.000
3.0622	0.154	0.471	0.050	0.000
3.1388	0.154	0.483	0.051	0.000
3.2153	0.154	0.495	0.051	0.000
3.2919	0.154	0.506	0.052	0.000
3.3684	0.154	0.518	0.052	0.000
3.4450	0.154	0.530	0.053	0.000
3.5216	0.154	0.542	0.054	0.000
3.5981	0.154	0.553	0.070	0.000
3.6747	0.154	0.565	0.079	0.000
3.7512	0.154	0.577	0.085	0.000
3.8278	0.154	0.589	0.091	0.000
3.9043	0.154	0.601	0.096	0.000
3.9809	0.154	0.612	0.100	0.000
4.0574	0.154	0.624	0.109	0.000
4.1340	0.154	0.636	0.116	0.000
4.2106	0.154	0.648	0.122	0.000
4.2871	0.154	0.660	0.128	0.000
4.3637	0.154	0.671	0.133	0.000
4.4402	0.154	0.683	0.137	0.000
4.5168	0.154	0.695	0.142	0.000
4.5933	0.154	0.707	0.146	0.000
4.6699	0.154	0.718	0.150	0.000
4.7464	0.154	0.730	0.154	0.000
4.8230	0.154	0.742	0.158	0.000
4.8996	0.154	0.754	0.161	0.000
4.9761	0.154	0.766	0.165	0.000
5.0527	0.154	0.777	0.168	0.000
5.1292	0.154	0.789	0.172	0.000
5.2058	0.154	0.801	0.175	0.000
5.2823	0.154	0.813	0.178	0.000
5.3589	0.154	0.825	0.181	0.000
5.4354	0.154	0.836	0.184	0.000
5.5120	0.154	0.848	0.187	0.000
5.5886	0.154	0.860	0.190	0.000
5.6651	0.154	0.872	0.193	0.000
5.7417	0.154	0.884	0.196	0.000
5.8182	0.154	0.895	0.199	0.000
5.8948	0.154	0.907	0.207	0.000
5.9713	0.154	0.919	0.573	0.000
6.0479	0.154	0.931	1.199	0.000
6.1244	0.154	0.942	1.978	0.000
6.2010	0.154	0.954	2.839	0.000
6.2776	0.154	0.966	3.710	0.000
6.3541	0.154	0.978	4.518	0.000
6.4307	0.154	0.990	5.203	0.000
6.5072	0.154	1.001	5.726	0.000
6.5838	0.154	1.013	6.093	0.000
6.6603	0.154	1.025	6.447	0.000
6.7369	0.154	1.037	6.751	0.000
6.8134	0.154	1.049	7.042	0.000
6.8900	0.154	1.060	7.321	0.000
6.9666	0.154	1.072	7.589	0.000
7.0431	0.000	0.000	7.849	0.000

Analysis Results

POC 1



+ Predeveloped x Mitigated



Predeveloped Landuse Totals for POC #1

Total Pervious Area: 2.64
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.59
Total Impervious Area: 2.06

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.098653
5 year	0.158558
10 year	0.196562
25 year	0.241385
50 year	0.27223
100 year	0.300912

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.060687
5 year	0.098169
10 year	0.130283
25 year	0.180606
50 year	0.226152
100 year	0.279495

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.112	0.041
1950	0.126	0.052
1951	0.201	0.166
1952	0.070	0.037
1953	0.054	0.046
1954	0.078	0.048
1955	0.138	0.048
1956	0.107	0.071
1957	0.095	0.048
1958	0.095	0.050

1959	0.080	0.043
1960	0.145	0.150
1961	0.078	0.052
1962	0.053	0.037
1963	0.071	0.048
1964	0.093	0.049
1965	0.066	0.078
1966	0.062	0.045
1967	0.147	0.051
1968	0.082	0.046
1969	0.084	0.043
1970	0.072	0.046
1971	0.076	0.050
1972	0.158	0.125
1973	0.075	0.063
1974	0.076	0.050
1975	0.116	0.047
1976	0.080	0.049
1977	0.013	0.042
1978	0.073	0.051
1979	0.040	0.037
1980	0.185	0.140
1981	0.060	0.046
1982	0.138	0.127
1983	0.104	0.049
1984	0.068	0.041
1985	0.038	0.044
1986	0.171	0.089
1987	0.150	0.140
1988	0.062	0.042
1989	0.037	0.043
1990	0.337	0.151
1991	0.188	0.141
1992	0.080	0.051
1993	0.076	0.041
1994	0.026	0.036
1995	0.099	0.052
1996	0.229	0.164
1997	0.192	0.149
1998	0.055	0.043
1999	0.187	0.130
2000	0.079	0.053
2001	0.016	0.036
2002	0.089	0.102
2003	0.125	0.046
2004	0.162	0.178
2005	0.110	0.049
2006	0.115	0.054
2007	0.255	0.279
2008	0.326	0.175
2009	0.151	0.094

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3372	0.2792
2	0.3264	0.1783
3	0.2551	0.1747

4	0.2294	0.1659
5	0.2012	0.1640
6	0.1924	0.1510
7	0.1880	0.1497
8	0.1865	0.1485
9	0.1852	0.1408
10	0.1711	0.1401
11	0.1621	0.1396
12	0.1575	0.1304
13	0.1511	0.1275
14	0.1504	0.1253
15	0.1473	0.1018
16	0.1445	0.0939
17	0.1383	0.0888
18	0.1380	0.0782
19	0.1258	0.0712
20	0.1245	0.0631
21	0.1159	0.0539
22	0.1145	0.0532
23	0.1115	0.0524
24	0.1096	0.0522
25	0.1071	0.0516
26	0.1036	0.0511
27	0.0992	0.0509
28	0.0954	0.0509
29	0.0951	0.0505
30	0.0932	0.0504
31	0.0888	0.0501
32	0.0839	0.0494
33	0.0824	0.0494
34	0.0805	0.0491
35	0.0798	0.0490
36	0.0796	0.0484
37	0.0787	0.0483
38	0.0783	0.0483
39	0.0779	0.0478
40	0.0765	0.0470
41	0.0760	0.0463
42	0.0758	0.0462
43	0.0747	0.0462
44	0.0733	0.0458
45	0.0720	0.0456
46	0.0708	0.0453
47	0.0700	0.0439
48	0.0680	0.0434
49	0.0663	0.0428
50	0.0623	0.0427
51	0.0623	0.0425
52	0.0595	0.0424
53	0.0555	0.0423
54	0.0544	0.0413
55	0.0533	0.0411
56	0.0400	0.0406
57	0.0385	0.0369
58	0.0374	0.0367
59	0.0258	0.0365
60	0.0156	0.0361
61	0.0126	0.0359

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0493	13291	11937	89	Pass
0.0516	12189	8382	68	Pass
0.0538	11221	5356	47	Pass
0.0561	9965	3918	39	Pass
0.0583	9163	3837	41	Pass
0.0606	8427	3758	44	Pass
0.0628	7798	3685	47	Pass
0.0651	6992	3585	51	Pass
0.0673	6485	3516	54	Pass
0.0696	6027	3454	57	Pass
0.0718	5619	3362	59	Pass
0.0741	5033	3193	63	Pass
0.0763	4678	3084	65	Pass
0.0786	4346	2988	68	Pass
0.0808	4100	2887	70	Pass
0.0831	3728	2704	72	Pass
0.0854	3506	2586	73	Pass
0.0876	3294	2460	74	Pass
0.0899	3104	2348	75	Pass
0.0921	2845	2199	77	Pass
0.0944	2671	2093	78	Pass
0.0966	2513	2003	79	Pass
0.0989	2357	1910	81	Pass
0.1011	2107	1709	81	Pass
0.1034	1962	1655	84	Pass
0.1056	1829	1605	87	Pass
0.1079	1687	1560	92	Pass
0.1101	1532	1484	96	Pass
0.1124	1425	1424	99	Pass
0.1146	1343	1368	101	Pass
0.1169	1255	1305	103	Pass
0.1191	1127	1207	107	Pass
0.1214	1052	1135	107	Pass
0.1236	995	1066	107	Pass
0.1259	949	993	104	Pass
0.1281	892	868	97	Pass
0.1304	851	811	95	Pass
0.1326	807	768	95	Pass
0.1349	765	722	94	Pass
0.1371	706	649	91	Pass
0.1394	669	601	89	Pass
0.1416	638	548	85	Pass
0.1439	602	516	85	Pass
0.1461	559	447	79	Pass
0.1484	525	414	78	Pass
0.1506	487	373	76	Pass
0.1529	441	345	78	Pass
0.1551	396	318	80	Pass
0.1574	368	293	79	Pass
0.1597	336	270	80	Pass
0.1619	310	240	77	Pass
0.1642	272	206	75	Pass
0.1664	250	184	73	Pass

0.1687	225	171	76	Pass
0.1709	202	152	75	Pass
0.1732	175	129	73	Pass
0.1754	154	108	70	Pass
0.1777	139	86	61	Pass
0.1799	129	70	54	Pass
0.1822	115	63	54	Pass
0.1844	99	58	58	Pass
0.1867	89	55	61	Pass
0.1889	79	49	62	Pass
0.1912	68	43	63	Pass
0.1934	57	40	70	Pass
0.1957	53	36	67	Pass
0.1979	49	29	59	Pass
0.2002	44	19	43	Pass
0.2024	42	16	38	Pass
0.2047	41	15	36	Pass
0.2069	40	12	30	Pass
0.2092	35	6	17	Pass
0.2114	33	6	18	Pass
0.2137	31	6	19	Pass
0.2159	29	5	17	Pass
0.2182	27	5	18	Pass
0.2204	25	5	20	Pass
0.2227	22	5	22	Pass
0.2249	19	5	26	Pass
0.2272	17	4	23	Pass
0.2295	14	4	28	Pass
0.2317	13	4	30	Pass
0.2340	12	4	33	Pass
0.2362	11	4	36	Pass
0.2385	7	4	57	Pass
0.2407	6	4	66	Pass
0.2430	6	4	66	Pass
0.2452	5	4	80	Pass
0.2475	5	4	80	Pass
0.2497	4	3	75	Pass
0.2520	4	3	75	Pass
0.2542	4	3	75	Pass
0.2565	3	2	66	Pass
0.2587	3	2	66	Pass
0.2610	3	2	66	Pass
0.2632	3	2	66	Pass
0.2655	3	2	66	Pass
0.2677	3	2	66	Pass
0.2700	3	2	66	Pass
0.2722	3	2	66	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0.0859 acre-feet

On-line facility target flow: 0.0436 cfs.

Adjusted for 15 min: 0.0436 cfs.

Off-line facility target flow: 0.0285 cfs.

Adjusted for 15 min: 0.0285 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	<input type="checkbox"/>	342.43			<input type="checkbox"/>	0.00			
Total Volume Infiltrated		342.43	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WWMH4 model simulation
START      1948 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM 1
```

END GLOBAL

FILES

```
<File>  <Un#>  <-----File Name----->***
<-ID->                                     ***
WDM      26     UPS REDMOND.wdm
MESSU    25     PreUPS REDMOND.MES
          27     PreUPS REDMOND.L61
          28     PreUPS REDMOND.L62
          30     POCUPS REDMOND1.dat
```

END FILES

OPN SEQUENCE

```
INGRP                      INDELT 00:15
  PERLND      11
  PERLND      12
  COPY        501
  DISPLY      1
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INFO1

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
1   Basin 1                                MAX          1   2   30   9
```

END DISPLY-INFO1

END DISPLY

COPY

TIMESERIES

```
# - #  NPT  NMN  ***
1   1   1
501 1   1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
# # OPCD ***
```

END OPCODE

PARM

```
# # K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User  t-series  Engl Metr ***
                      in  out      ***
```

```
11      C, Forest, Mod      1   1   1   1   27   0
12      C, Forest, Steep    1   1   1   1   27   0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC ***
11      0      0      1      0      0      0      0      0      0      0      0
12      0      0      1      0      0      0      0      0      0      0      0
```

END ACTIVITY

PRINT-INFO

```
<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC *****
```

```

11      0      0      4      0      0      0      0      0      0      0      0      0      1      9
12      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VNN VIFW VIRC VLE INFC HWT ***
11      0      0      0      0      0      0      0      0      0      0      0
12      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARY AGWRC
11      0      4.5      0.08      400      0.1      0.5      0.996
12      0      4.5      0.08      400      0.15      0.5      0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
11      0      0      2      2      0      0      0
12      0      0      2      2      0      0      0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
11      0.2      0.5      0.35      6      0.5      0.7
12      0.2      0.3      0.35      6      0.3      0.7
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
11      0      0      0      0      2.5      1      0
12      0      0      0      0      2.5      1      0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engl Metr ***
in out ***
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT SLD IWG IQAL ***
END ACTIVITY

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW IWAT SLD IWG IQAL *****
END PRINT-INFO

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS VNN RTLI ***
END IWAT-PARM1

IWAT-PARM2
<PLS > IWATER input info: Part 2 ***
# - # *** LSUR SLSUR NSUR RETSC
END IWAT-PARM2

IWAT-PARM3

```

```

      <PLS >          IWATER input info: Part 3          ***
      # - # ***PETMAX      PETMIN
END IWAT-PARM3

IWAT-STATE1
      <PLS > *** Initial conditions at start of simulation
      # - # *** RETS      SURS
END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->          <--Area-->          <-Target->      MBLK      ***
<Name> #          <-factor->          <Name> #      Tbl#      ***
Basin 1***
PERLND 11          1.32      COPY      501      12
PERLND 11          1.32      COPY      501      13
PERLND 12          1.32      COPY      501      12
PERLND 12          1.32      COPY      501      13

*****Routing*****
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #          <Name> # #<-factor->strg <Name> # #          <Name> # #          ***
COPY      501 OUTPUT MEAN      1 1      48.4      DISPLY      1      INPUT TIMSER 1

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #          <Name> # #<-factor->strg <Name> # #          <Name> # #          ***
END NETWORK

RCHRES
GEN-INFO
RCHRES      Name      Nexits      Unit Systems      Printer      ***
# - #<-----><----> User T-series      Engl Metr LKFG      ***
      in out      ***
END GEN-INFO
*** Section RCHRES***

ACTIVITY
      <PLS > ***** Active Sections *****
      # - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUGF PKFG PHFG ***
END ACTIVITY

PRINT-INFO
      <PLS > ***** Print-flags ***** PIVL      PYR
      # - # HYDR ADCA CONS HEAT      SED      GQL OXRX NUTR PLNK PHCB PIVL      PYR      *****
END PRINT-INFO

HYDR-PARM1
RCHRES      Flags for each HYDR Section      ***
# - #      VC A1 A2 A3      ODFVFG for each *** ODGTFG for each      FUNCT for each
      FG FG FG FG      possible exit *** possible exit      possible exit
      * * * *      * * * *      * * * *      * * * *      * * * *
END HYDR-PARM1

HYDR-PARM2
# - #      FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><----->      ***
END HYDR-PARM2
HYDR-INIT
RCHRES      Initial conditions for each HYDR section      ***
# - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
      *** ac-ft      for each possible exit      for each possible exit
<-----><----->      <----><----><----><----><----> *** <----><----><----><----><---->
END HYDR-INIT
END RCHRES

```

SPEC-ACTIONS
 END SPEC-ACTIONS
 FTABLES
 END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap<--Mult-->	Tran	<-Target	vols>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	tem strg<-factor->	strg	<Name>	#	#
WDM	2	PREC	ENGL	1		PERLND	1	999
WDM	2	PREC	ENGL	1		IMPLND	1	999
WDM	1	EVAP	ENGL	0.76		PERLND	1	999
WDM	1	EVAP	ENGL	0.76		IMPLND	1	999

END EXT SOURCES

EXT TARGETS

<-Volume->	<-Grp>	<-Member->	<--Mult-->	Tran	<-Volume->	<Member>	Tsys	Tgap	Amd	***
<Name>	#	<Name>	#	#<-factor->	strg	<Name>	#	<Name>	tem strg	strg***
COPY	501	OUTPUT	MEAN	1	1	48.4	WDM	501	FLOW	ENGL
										REPL

END EXT TARGETS

MASS-LINK

<Volume>	<-Grp>	<-Member->	<--Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>		<Name>	#	#<-factor->	<Name>		<Name>
MASS-LINK			12				
PERLND	PWATER	SURO		0.083333	COPY	INPUT	MEAN
		END MASS-LINK	12				
MASS-LINK			13				
PERLND	PWATER	IFWO		0.083333	COPY	INPUT	MEAN
		END MASS-LINK	13				

END MASS-LINK

END RUN

Mitigated UCI File

RUN

GLOBAL

```
WWM4 model simulation
START      1948 10 01      END      2009 09 30
RUN INTERP OUTPUT LEVEL    3      0
RESUME     0 RUN          1
UNIT SYSTEM 1
```

END GLOBAL

FILES

```
<File>  <Un#>  <-----File Name----->***
<-ID->                                     ***
WDM      26     UPS REDMOND.wdm
MESSU    25     MitUPS REDMOND.MES
          27     MitUPS REDMOND.L61
          28     MitUPS REDMOND.L62
          30     POCUPS REDMOND1.dat
```

END FILES

OPN SEQUENCE

```
INGRP          INDELT 00:15
  PERLND        16
  PERLND        17
  PERLND        18
  IMPLND        12
  RCHRES         1
  COPY           1
  COPY          501
  DISPLY         1
```

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INFO1

```
# - #<-----Title----->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
1      Vault 1      MAX      1      2      30      9
```

END DISPLY-INFO1

END DISPLY

COPY

TIMESERIES

```
# - #  NPT  NMN  ***
1      1      1
501     1      1
```

END TIMESERIES

END COPY

GENER

OPCODE

```
#      # OPCODE ***
```

END OPCODE

PARM

```
#      #      K ***
```

END PARM

END GENER

PERLND

GEN-INFO

```
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #      User      t-series      Engl Metr ***
                        in  out
16      C, Lawn, Flat      1      1      1      1      27      0
17      C, Lawn, Mod      1      1      1      1      27      0
18      C, Lawn, Steep    1      1      1      1      27      0
```

END GEN-INFO

*** Section PWATER***

ACTIVITY

```
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST NITR PHOS TRAC ***
16      0      0      1      0      0      0      0      0      0      0      0      0
17      0      0      1      0      0      0      0      0      0      0      0      0
```

```

18      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL MSTL PEST  NITR PHOS TRAC  *****
16      0      0      4      0      0      0      0      0      0      0      0      1      9
17      0      0      4      0      0      0      0      0      0      0      0      1      9
18      0      0      4      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
16      0      0      0      0      0      0      0      0      0      0      0
17      0      0      0      0      0      0      0      0      0      0      0
18      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

PWAT-PARM2
<PLS > PWATER input info: Part 2 *****
# - # ***FOREST  LZSN  INFILT  LSUR  SLSUR  KVARV  AGWRC
16      0      4.5  0.03  400  0.05  0.5  0.996
17      0      4.5  0.03  400  0.1  0.5  0.996
18      0      4.5  0.03  400  0.15  0.5  0.996
END PWAT-PARM2

PWAT-PARM3
<PLS > PWATER input info: Part 3 *****
# - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
16      0      0      2      2      0      0      0
17      0      0      2      2      0      0      0
18      0      0      2      2      0      0      0
END PWAT-PARM3

PWAT-PARM4
<PLS > PWATER input info: Part 4 *****
# - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
16      0.1  0.25  0.25  6  0.5  0.25
17      0.1  0.25  0.25  6  0.5  0.25
18      0.1  0.15  0.25  6  0.3  0.25
END PWAT-PARM4

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS  SURS  UZS  IFWS  LZS  AGWS  GWVS
16      0      0      0      0  2.5  1  0
17      0      0      0      0  2.5  1  0
18      0      0      0      0  2.5  1  0
END PWAT-STATE1

END PERLND

IMPLND
GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engl Metr ***
in out ***
12 PARKING/MOD 1 1 1 27 0
END GEN-INFO
*** Section IWATER***

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL ***
12      0      0      1      0      0      0
END ACTIVITY

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR

```

```

# - # ATMP SNOW IWAT SLD IWG IQAL *****
12      0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS VNN RTLI ***
12      0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS > IWATER input info: Part 2 ***
# - # *** LSUR SLSUR NSUR RETSC
12      400      0.05      0.1      0.08
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS > IWATER input info: Part 3 ***
# - # ***PETMAX PETMIN
12      0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # *** RETS SURS
12      0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->          <--Area-->      <-Target->      MBLK      ***
<Name> #          <-factor-->      <Name> #      Tbl#      ***
Basin 1***
PERLND 16          0.27      RCHRES 1      2
PERLND 16          0.27      RCHRES 1      3
PERLND 17          0.17      RCHRES 1      2
PERLND 17          0.17      RCHRES 1      3
PERLND 18          0.15      RCHRES 1      2
PERLND 18          0.15      RCHRES 1      3
IMPLND 12          2.06      RCHRES 1      5

```

```

*****Routing*****
PERLND 16          0.27      COPY 1      12
PERLND 17          0.17      COPY 1      12
PERLND 18          0.15      COPY 1      12
IMPLND 12          2.06      COPY 1      15
PERLND 16          0.27      COPY 1      13
PERLND 17          0.17      COPY 1      13
PERLND 18          0.15      COPY 1      13
RCHRES 1          1      COPY 501      16
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #      <Name> # #<-factor-->strg <Name> # #      <Name> # #      ***
COPY 501 OUTPUT MEAN 1 1 48.4      DISPLY 1      INPUT TIMSER 1

```

```

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #      <Name> # #<-factor-->strg <Name> # #      <Name> # #      ***
END NETWORK

```

```

RCHRES
GEN-INFO
RCHRES      Name      Nexits      Unit Systems      Printer      ***
# - #<-----><----> User T-series Engl Metr LKFG      ***
in out
1      Vault 1      1      1      1      1      28      0      1      ***

```

```

END GEN-INFO
*** Section RCHRES***

ACTIVITY
<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
1      1      0      0      0      0      0      0      0      0
END ACTIVITY

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL  PYR
# - # HYDR ADCA CONS HEAT SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *****
1      4      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

HYDR-PARM1
RCHRES  Flags for each HYDR Section
# - # VC A1 A2 A3 ODFVFG for each *** ODGTFG for each  FUNCT for each
      FG FG FG FG possible exit *** possible exit  possible exit
      * * * * * * * * * * * * * * * * * * * * * *
1      0 1 0 0      4 0 0 0 0      0 0 0 0 0      2 2 2 2 2
END HYDR-PARM1

HYDR-PARM2
# - # FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<-----><-----><-----><-----><-----><-----><----->
1      1      0.02      0.0      0.0      0.5      0.0      ***
END HYDR-PARM2

HYDR-INIT
RCHRES  Initial conditions for each HYDR section
# - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
      *** ac-ft      for each possible exit      for each possible exit
<-----><----->      <-----><-----><-----><-----><-----> *** <-----><-----><-----><-----><----->
1      0      4.0 0.0 0.0 0.0 0.0      0.0 0.0 0.0 0.0 0.0
END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
FTABLE 1
92 4
Depth      Area      Volume      Outflow1 Velocity      Travel Time***
(ft)      (acres) (acre-ft) (cfs)      (ft/sec) (Minutes)***
0.000000  0.153954  0.000000  0.000000
0.076556  0.153954  0.011786  0.007966
0.153111  0.153954  0.023572  0.011265
0.229667  0.153954  0.035358  0.013797
0.306222  0.153954  0.047144  0.015931
0.382778  0.153954  0.058930  0.017812
0.459333  0.153954  0.070716  0.019512
0.535889  0.153954  0.082502  0.021075
0.612444  0.153954  0.094288  0.022530
0.689000  0.153954  0.106074  0.023897
0.765556  0.153954  0.117861  0.025190
0.842111  0.153954  0.129647  0.026419
0.918667  0.153954  0.141433  0.027594
0.995222  0.153954  0.153219  0.028721
1.071778  0.153954  0.165005  0.029805
1.148333  0.153954  0.176791  0.030851
1.224889  0.153954  0.188577  0.031863
1.301444  0.153954  0.200363  0.032843
1.378000  0.153954  0.212149  0.033795
1.454556  0.153954  0.223935  0.034721
1.531111  0.153954  0.235721  0.035623
1.607667  0.153954  0.247507  0.036503
1.684222  0.153954  0.259293  0.037362
1.760778  0.153954  0.271079  0.038202
1.837333  0.153954  0.282865  0.039024
1.913889  0.153954  0.294651  0.039828

```

1.990444	0.153954	0.306437	0.040617
2.067000	0.153954	0.318223	0.041391
2.143556	0.153954	0.330010	0.042150
2.220111	0.153954	0.341796	0.042896
2.296667	0.153954	0.353582	0.043630
2.373222	0.153954	0.365368	0.044351
2.449778	0.153954	0.377154	0.045061
2.526333	0.153954	0.388940	0.045759
2.602889	0.153954	0.400726	0.046447
2.679444	0.153954	0.412512	0.047125
2.756000	0.153954	0.424298	0.047794
2.832556	0.153954	0.436084	0.048453
2.909111	0.153954	0.447870	0.049104
2.985667	0.153954	0.459656	0.049746
3.062222	0.153954	0.471442	0.050379
3.138778	0.153954	0.483228	0.051005
3.215333	0.153954	0.495014	0.051623
3.291889	0.153954	0.506800	0.052234
3.368444	0.153954	0.518586	0.052838
3.445000	0.153954	0.530372	0.053435
3.521556	0.153954	0.542159	0.054026
3.598111	0.153954	0.553945	0.070510
3.674667	0.153954	0.565731	0.079234
3.751222	0.153954	0.577517	0.085820
3.827778	0.153954	0.589303	0.091383
3.904333	0.153954	0.601089	0.096313
3.980889	0.153954	0.612875	0.100798
4.057444	0.153954	0.624661	0.109012
4.134000	0.153954	0.636447	0.116500
4.210556	0.153954	0.648233	0.122559
4.287111	0.153954	0.660019	0.127973
4.363667	0.153954	0.671805	0.132966
4.440222	0.153954	0.683591	0.137648
4.516778	0.153954	0.695377	0.142083
4.593333	0.153954	0.707163	0.146312
4.669889	0.153954	0.718949	0.150368
4.746444	0.153954	0.730735	0.154274
4.823000	0.153954	0.742521	0.158046
4.899556	0.153954	0.754307	0.161700
4.976111	0.153954	0.766094	0.165248
5.052667	0.153954	0.777880	0.168699
5.129222	0.153954	0.789666	0.172062
5.205778	0.153954	0.801452	0.175344
5.282333	0.153954	0.813238	0.178550
5.358889	0.153954	0.825024	0.181688
5.435444	0.153954	0.836810	0.184761
5.512000	0.153954	0.848596	0.187773
5.588556	0.153954	0.860382	0.190728
5.665111	0.153954	0.872168	0.193630
5.741667	0.153954	0.883954	0.196482
5.818222	0.153954	0.895740	0.199286
5.894778	0.153954	0.907526	0.207306
5.971333	0.153954	0.919312	0.573400
6.047889	0.153954	0.931098	1.199070
6.124444	0.153954	0.942884	1.978353
6.201000	0.153954	0.954670	2.839625
6.277556	0.153954	0.966456	3.710388
6.354111	0.153954	0.978243	4.518740
6.430667	0.153954	0.990029	5.203139
6.507222	0.153954	1.001815	5.726514
6.583778	0.153954	1.013601	6.093457
6.660333	0.153954	1.025387	6.447444
6.736889	0.153954	1.037173	6.751569
6.813444	0.153954	1.048959	7.042310
6.890000	0.153954	1.060745	7.321299
6.966556	0.153954	1.072531	7.589861

END FTABLE 1

END FTABLES

EXT SOURCES

```

<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # tem strg<-factor->strg <Name> # # <Name> # # ***
WDM 2 PREC ENGL 1 PERLND 1 999 EXTNL PREC
WDM 2 PREC ENGL 1 IMPLND 1 999 EXTNL PREC
WDM 1 EVAP ENGL 0.76 PERLND 1 999 EXTNL PETINP
WDM 1 EVAP ENGL 0.76 IMPLND 1 999 EXTNL PETINP

```

END EXT SOURCES

EXT TARGETS

```

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name> # <Name> # #<-factor->strg <Name> # <Name> tem strg strg***
RCHRES 1 HYDR RO 1 1 1 WDM 1002 FLOW ENGL REPL
RCHRES 1 HYDR STAGE 1 1 1 WDM 1003 STAG ENGL REPL
COPY 1 OUTPUT MEAN 1 1 48.4 WDM 701 FLOW ENGL REPL
COPY 501 OUTPUT MEAN 1 1 48.4 WDM 801 FLOW ENGL REPL
END EXT TARGETS

```

MASS-LINK

```

<Volume> <-Grp> <-Member-><--Mult--> <Target> <-Grp> <-Member->***
<Name> <Name> # #<-factor-> <Name> <Name> # #***
MASS-LINK 2
PERLND PWATER SURO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 2

MASS-LINK 3
PERLND PWATER IFWO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 3

MASS-LINK 5
IMPLND IWATER SURO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 5

MASS-LINK 12
PERLND PWATER SURO 0.083333 COPY INPUT MEAN
END MASS-LINK 12

MASS-LINK 13
PERLND PWATER IFWO 0.083333 COPY INPUT MEAN
END MASS-LINK 13

MASS-LINK 15
IMPLND IWATER SURO 0.083333 COPY INPUT MEAN
END MASS-LINK 15

MASS-LINK 16
RCHRES ROFLOW COPY INPUT MEAN
END MASS-LINK 16

```

END MASS-LINK

END RUN

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2017; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com